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VOLUME II

APPENDICES

STATISTICAL EVALUATION OF TIME SERIES ANALYSIS TECHNIQUES

Final Report

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APPENDIX 1

Listing of Program and Documentation of Use

U S E   O F   S P E C T

THE FOLLOWING IS A LIST OF INPUT PARAMETERS AND DATA CARDS AND THEIR INTERPRETATIONS.

```
JDOMAN-DOMAIN OF ANALYSIS.  0 OR BLANK=PERIOD, 1=FREQUENCY.
JBANDS-HOW VECTOR OF FREQUENCY OR PERIOD BANDS WILL BE OBTAINED.
        0 OR BLANK=GENERATE ACCORDING TO LIMITS SUBSEQUENTLY READ IN.
        1=READ IN A VECTOR OF BANDS TO BE USED FROM CARDS.
NBANDS-HOW MANY FREQUENCY OR PERIOD BANDS WILL BE USED.
NOBS-THE NUMBER OF OBSERVATIONS IN THE DATA VECTOR
JANALY-HOW THE DATA SHALL BE ANALYZED.
        0 OR BLANK=DO UNIVARIATE SPECTRUM, SEARCH FOR BEST K-VARIATE
              MODEL
        1=SIMPLY DO UNIVARIATE SPECTRUM
        2=DO K-VARIATE SPECTRUM ACCORDING TO MODEL PARAMETER READ IN
JDATA-TELLS SUBROUTINE DEPVAR WHERE TO GET DATA.
       0 OR BLANK=READ FROM CARDS ACCORDING TO FORMAT (10X,7F10.0)
       1=GENERATE DATA FROM MODELING PROGRAM CALLED BY DATA.  THIS
         MODELING PROGRAM WILL ASK FOR MORE CARDS.
JCRITR-SELECTS CRITERION FOR OPTIMIZATION OF K-VARIATE SPECTRUM.
        0 OR BLANK=MULTIPLE R-SQUARED
        1=T-VALUES
JPRINT-PRINTOUT CONTROL DIGIT
        0=DONT PRINT ANY RESULTS
        1=PRINT ONLY FINAL RESULTS
        2=PRINT FINAL AND INTERMEDIATE RESULTS
        3=PRINT AS FOR 2 PLUS MATRICES, CORRELATIONS,ETC FOR EACH STEP
JPLOT-PLOT CONTROL DIGIT. - VALUES AS ABOVE EXCEPT FOR 3.

BANDLO-LOWEST FREQ. OR LONGEST PERIOD, AS APPROPRIATE TO DOMAIN.
BANDEL-DELTA(FREQ.) OR DELTA(PERIOD), AS APPROPRIATE TO DOMAIN.

BANDS-VECTOR OF BANDS.

NSIN-NUMBER OF SINE WAVES IN SIMULATED DATA.
BAND-FREQ. OR PERIOD OF THE LSINTH SIMULATED SINE WAVE
SD-STANDARD DEVIATION OF THE LSINTH SIMULATED SINE WAVE.  (AMPLITUDE)
SDN-STANDARD DEV. OF GAUSSIAN NOISE
```

THE FOLLOWING IS A LIST OF INPUT CARDS AND THEIR CONTENTS

```
CARD 1 - - - MANDATORY
   COLUMN    VARIABLE    COMMENTS - - -
    1 -  5 -  JDUMAN       RIGHT JUSTIFY
    6 - 10 -  JBANDS       RIGHT JUSTIFY
   11 - 15 -  NBANDS       RIGHT JUSTIFY
   16 - 20 -  NOBS         RIGHT JUSTIFY
   21 - 25 -  JANALY       RIGHT JUSTIFY
   26 - 30 -  JDATA        RIGHT JUSTIFY
   31 - 35 -  JCRITR       RIGHT JUSTIFY
   36 - 40 -  JPRINT       RIGHT JUSTIFY
   41 - 45 -  JPLOT

CARD 2 - - - REQUIRED ONLY IF JBANDS=0, OTHERWISE OMIT.
   COLUMN    VARIABLE    COMMENTS - - -
    1 - 10 -  BANDLO       PUNCH DECIMAL
   11 - 20 -  BANDEL       PUNCH DECIMAL

CARDS 3 - - - REQUIRED ONLY IF JBANDS=1.
   COLUMN    VARIABLE    COMMENTS - - -
    1 - 10 -  BANDS(1)     PUNCH DECIMAL - 1ST BAND IN SPECTRUM.
   11 - 20 -  BANDS(2)     PUNCH DECIMAL - 2ND BAND IN SPECTRUM.
    *
    *
   CONTINUE FOR AS MANY CARDS AS NEEDED TO READ IN NBANDS BANDS.
   FORMAT(8F10.0)

CARDS 4 - - - REQUIRED ONLY IF JDATA=0.
   COLUMN    VARIABLE    COMMENTS - - -
    1 - 10 -  ID CODE      MAY CONTAIN ANYTHING - NOT READ.
   11 - 20 -  DATA(1)      1ST DATA POINT.  PUNCH DECIMAL OR RIGHT JUSTIFY.
   21 - 30 -  DATA(2)      2ND DATA POINT.  PUNCH DECIMAL OR RIGHT JUSTIFY.
    *
    *
   CONTINUE SAME FORMAT ON CARDS AS NEEDED FOR NOBS DATA POINTS.
   FORMAT(10X,7F10.0)

CARDS 5 - - - REQUIRED ONLY IF JDATA=1.
  5A - - MANDATORY.
   COLUMN    VARIABLE    COMMENTS - - -
    1 -  5 -  NSIN         RIGHT JUSTIFY.

  5B - - REQUIRED ONLY IF NSIN IS NOT ZERO.
   COLUMN    VARIABLE    COMMENTS - - -
    1 - 10 -  BAND(1)      PUNCH DECIMAL.
   11 - 20 -  SD(1)        PUNCH DECIMAL.
   CONTINUE SAME FORMAT THRU NSIN CARDS (BANDS).  FORMAT(2F10.0)

  5C - - MANDATORY
   COLUMN    VARIABLE    COMMENTS - - -
    1 - 10 -  SDN          PUNCH DECIMAL

  5D - - REQUIRED ONLY IF SDN IS NOT ZERO
   COLUMN    VARIABLE    COMMENTS - - -
    1 -  4    ID CODE      MAY CONTAIN ANYTHING - NOT READ.
    5 - 10    NOISE(1)     PUNCH DECIMAL.  1ST GAUSSIAN RANDOM NUMBER.
   11 - 16    NOISE(2)     PUNCH DECIMAL.  2ND GAUSSIAN RANDOM NUMBER.
    *
    *
   CONTINUE THRU AS MANY CARDS AS NEEDED FOR NOBS RANDOM NUMBERS.
   FORMAT(4X,12F6.4)
```

```
C
C
C***********************************************************************
C***********************************************************************
C
C
      DIMENSION BANDS( 50),BAN( 50),PEAKS(50),PHASE(50),AMNAME(9),TNAME
     1(9),PHNAME(9),BANAME(5),XNAME(5),LVAR(100),ISAVE(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- NOBS*(NBANDS*2+1)
C
      DIMENSION X(30000)
C
C-THE FOLLOWING DIMENSIONS MUST BE EQUAL TO OR GREATER THAN NBANDS*2+1
C
      DIMENSION XBAR(100),STD(100),B(100),D(100),T(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- M*M, WHERE M=2*NBANDS+1
C
      DIMENSION RX(10000)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN (M+1)*M/2
C
      DIMENSION R(5050)
      COMMON KREADR,KPRINT
      DATA AMNAME/'AMPL','ITUD','E ES','IMAT','E.  ','    ','    ','
     1','    '/
      DATA  TNAME/'T-VA','LUE.','    ','    ','    ','    ','
     1','    '/
      DATA PHNAME/'PHAS','E ES','TIMA','TE. ','    ','    ','
     1','    '/
      DATA BANAME/'FREQ','UENC','Y   ','    ','    '/
      DATA  XNAME/'PERI','OD  ','    ','    ','    '/
      KREADR=5
      KPRINT=6
C
C-READ IN CONTROL DIGITS AS FOLLOWS AND PRINT THEM OUT.
C  JDOMAN-DOMAIN OF ANALYSIS.  0 OR BLANK=PERIOD, 1=FREQUENCY.
C  JBANDS-HOW VECTOR OF FREQUENCY OR PERIOD BANDS WILL BE OBTAINED.
C        0 OR BLANK=GENERATE ACCORDING TO LIMITS SUBSEQUENTLY READ IN.
C        1=READ IN A VECTOR OF BANDS TO BE USED FROM CARDS.
C  NBANDS-HOW MANY FREQUENCY OR PERIOD BANDS WILL BE USED.
C  NOBS-THE NUMBER OF OBSERVATIONS IN THE DATA VECTOR
C  JANALY-HOW THE DATA SHALL BE ANALYZED.
C        0 OR BLANK=DO UNIVARIATE SPECTRUM, SEARCH FOR BEST K-VARIATE
C                   MODEL
C        1=SIMPLY DO UNIVARIATE SPECTRUM
C        2=DO K-VARIATE SPECTRUM ACCORDING TO MODEL PARAMETER READ IN
C  JDATA-TELLS SUBROUTINE DEPVAR WHERE TO GET DATA.
C       0 OR BLANK=READ FROM CARDS ACCORDING TO FORMAT (10X,7F10.0)
C       1=GENERATE DATA FROM MODELING PROGRAM CALLED BY DATA.  THIS
C          MODELING PROGRAM WILL ASK FOR MORE CARDS.
```

```
C  JCRITR-SELECTS CRITERION FOR OPTIMIZATION OF K-VARIATE SPECTRUM.
C          0 OR BLANK=MULTIPLE R-SQUARED
C          1=T-VALUES
C  JPRINT-PRINTOUT CONTROL DIGIT
C          0=DONT PRINT ANY RESULTS
C          1=PRINT ONLY FINAL RESULTS
C          2=PRINT FINAL AND INTERMEDIATE RESULTS
C          3=PRINT AS FOR 2 PLUS MATRICES, CORRELATIONS,ETC FOR EACH STEP
C  JPLOT-PLOT CONTROL DIGIT. - VALUES AS ABOVE EXCEPT FOR 3.
C
      READ (KREADR,1) JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
    1 FORMAT (16I5)
      WRITE (KPRINT,103)
  103 FORMAT ('1 * * * * * * *  PROGRAM PARAMETERS  * * * * * * * *')
      WRITE (KPRINT,1)JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
C
C-KTOP =MAX NUMBER OF TIMES THE PROGRAM WILL BE ALLOWED TO TRY IMPROVE-
C-MENTS ON THE WHOLE MULTIVARIATE SPECTRUM.  KOUNT IS THE NUMBER OF
C-SUCH TRIES.
C
      KTOP=4
      KOUNT=0
C
C-SET SIGLEV, THE T-VALUE FOR THE CRITERION OF ACCEPTANCE OF A PEAK.
C-THEN DECIDE HOW TO GET VECTOR OF BANDS.
C
      SIGLEV=2.0
      IF (JBANDS) 100,100,110
C
C-READ IN LIMITS OF BANDS VECTOR IF JBANDS WAS 0 - GENERATE BANDS.
C-OTHERWISE GO TO 110 AND READ IN BANDS FROM CARDS.
C  BANDLO-LOWEST FREQ. OR LONGEST PERIOD, AS APPROPRIATE TO DOMAIN.
C  BANDEL-DELTA(FREQ.) OR DELTA(PERIOD), AS APPROPRIATE TO DOMAIN.
C  BANDS-VECTOR OF BANDS.
C
  100 READ (KREADR,2) BANDLO,BANDEL
    2 FORMAT (8F10.0)
      BANDS(1)=BANDLO
      DO 120 LBAND=2,NBANDS
  120 BANDS(LBAND)=BANDS(LBAND-1) + BANDEL
      GO TO 130
  110 READ (KREADR,2) (BANDS(LBAND),LBAND=1,NBANDS)
C
C-CONVERT BANDS TO PERIOD DOMAIN IF ORIGINATED IN FREQ DOMAIN.
C-REVERSE THE ORDER OF BANDS SO AS TO BE IN ASCENDING WAVELENGTH ORDER.
C-ALSO GENERATE BAN, THE FREQ DOMAIN VECTOR OF BANDS.
C
  130 IF (JDOMAN) 150,150,140
  140 DO 141 LBAND=1,NBANDS
      BAN(LBAND)=BANDS(LBAND)
  141 BANDS(LBAND)=1.0/BANDS(LBAND)
      CALL REV(BANDS,NBANDS)
C
C-GENERATE SIN/COS PREDICTOR MATRIX AS PART OF DATA MATRIX, X.  THEN
```

```
C-READ IN DEPENDENT VARIABLE PART OF X.  THESE DATA WILL THEN BE ENT-
C-ERED INTO SUBROUTINE CORRE TO COMPUTE THE CORRELATION MATRIX OF ALL
C-VARIABLES.
C
  150 M=NBANDS*2 + 1
      CALL PREGEN(X,BANDS,NOBS,NBANDS)
      CALL DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
C
C-GENERATE VECTOR OF VARIABLE NUMBERS FOR LATER USE.
C
      DO 155 LV=1,M
  155 LVAR(LV)=LV
      CALL CORRE(NOBS,M,1,X,XBAR,STD,RX,R,B,D,T)
C
C-SET TOPP, THE MAXIMUM ALLOWABLE TOTAL AMPLITUDE IN THE FINAL SPECTRUM
C-TOPP IS THE TOTAL AMPLITUDE OF THE F(T)+25 PERCENT.
C
      TOPP=STD(1)+.25*STD(1)
C
C-PRINT OUT MATRICES ETC., IF DESIRED
C
      IF(JPRINT-3) 151,152,152
  152 WRITE (KPRINT,5)
    5 FORMAT('1M A T R I X    O F    C O R R E L A T I O N S',/,' VARIAB
     1LE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAV
     2ES OF VARIOUS PERIODS ',/,T88,'--------',/,'0')
      CALL MATPRT(R,M,LVAR)
C
C-DECIDE ON PROPER DATA ANALYSIS PATH.
C
  151 JANALY=JANALY+1
      GO TO (200,400,600),JANALY
C
C
C***********************************************************************
C***********************************************************************
C
C
C-STATEMENTS 200-400 INVOLVE COMPUTATION OF OPTIMIZED K-BANDS SPECTRA
C
C-FIRST COMPUTE UNIVARIATE SPECTRUM USING SUBROUTINE USPECT.  THEN FIND
C-ALL SIGNIFICANT SPECTRUM PEAKS IN UNIVARIATE SPECTRUM.
C
  200 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS
     1,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      CALL  PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      IF (NPEAK) 201,201,202
  201 WRITE (KPRINT,66)
   66 FORMAT('0** * *  * NO SIGNIFICANT PEAKS FOUND *  * * **')
      GO TO 2000
C
C-NOW LOOP THRU AN OPTIMIZING PROCESS TRYING TO FIND LARGEST VALUE OF
C-EITHER T OR R-SQUARE.  THE BEGINNING OF THIS LOOP IS STATEMENT 210
C
C-SET A VALUE OF CRIT=0.  THIS WILL LATER BE USED TO STORE THE JUST
C-PRECEDING VALUE OF THE OPTIMIZATION CRITERION.  ALSO INITIALIZE THE
```

```
C-VARIABLE MM =-1.  MM IS THE DIRECTION OF PEAK SLIDING AS WELL AS THE
C-COUNTER FOR THE NUMBER OF STEPS.
C
  202 LPEAK=1
      CRIT=0.0
      MM=0
  210 CALL KSPECT(R,T,NOBS,M,NPEAK,ISAVE,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE,BANDS,BAN)
C
C-TEST FOR PRINTOUT
C
      IF(JPRINT-3)208,209,209
  209 WRITE (KPRINT,6) RSQ
    6 FORMAT ('0MULTIPLE SQUARED CORRELATION=',F8.4)
      WRITE (KPRINT,7)
    7 FORMAT(' PERIOD/FREQ.',T20,'AMPLITUDE',T40,'T-VALUE')
      DO 214 LO=1,NPEAK
      KK=ISAVE(LO)
      IF (JDOMAN) 212,212,213
  212 BB=BANDS(KK)
      GO TO 214
  213 BB=BAN(KK)
  214 WRITE (KPRINT,8) BB,B(KK),T(KK)
    8 FORMAT (2F12.4,F18.4)
C
C-SELECT CRITERION FOR GOODNESS OF FIT - CHECK FOR IMPROVEMENT
C
  208 IF (CRITR(RSQ,T,JCRITR,LPEAK)-CRIT) 220,220,230
C
C-A BRANCH TO 220 IMPLIES NON-IMPROVEMENT.  EITHER RESORE OLD VALUE AND
C-GO TO NEXT PEAK (221 OR 223), OR TRY MOVING UP (222).
C
  220 IF (MM+1) 221,222,223
C
C-A BRANCH TO 221 IMPLIES THAT WE HAVE BEEN MOVING DOWN FOR 2 OR MORE
C-STEPS.  THIS IS THE FIRST NON-IMPROVEMENT.  RESTORE JUST FORMER VALUE
C-AND GO TO NEXT PEAK.
C
  221 ISAVE(LPEAK)=ISAVE(LPEAK)+1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C-A BRANCH TO 222 IMPLIES FIRST MOVE DOWN AND NON-IMPROVEMENT.  TRY
C-MOVING SAME PEAK UP
C
  222 MM=1
      ISAVE(LPEAK)=ISAVE(LPEAK)+2
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
  225 WRITE (KPRINT,3)
    3 FORMAT ('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK IN
     1TO THE LONGEST PERIOD (LOWEST FREQUENCY) BAND.  TRY WIDER SPECTRUM
     2 LIMITS.')
      GO TO 2000
C
```

```
C-A BRANCH TO 223 IMPLIES THAT WE HAVE BEEN MOVING UP AND IT DIDNT HELP.
C-RESTORE JUST PRIOR VALUE AND GO TO NEXT PEAK.
C
  223 ISAVE(LPEAK)=ISAVE(LPEAK)-1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C
C-A BRANCH TO 230 IMPLIES IMPROVEMENT.  CONTINUE IN SAME DIRECTION.
C
  230 IF (MM) 231,231,232
C
C-A BRANCH TO 231 IMPLIES WE WERE MOVING DOWN. - CONTINUE SAME DIRECTION
C
  231 MM=MM-1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK) =ISAVE(LPEAK)-1
      IF (ISAVE(LPEAK)-1) 234,234,300
  234 WRITE (KPRINT,4)
    4 FORMAT('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK INT
     1O THE SHORTEST PERIOD (HIGHEST FREQUENCY) BAND.  TRY WIDER SPECTRU
     2M LIMITS')
      GO TO 2000
C
C-A BRANCH TO 232 IMPLIES WE WERE MOVING UP. - CONTINUE SAME DIRECTION.
C
  232 MM=MM+1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK)=ISAVE(LPEAK)+1
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
C
C
C-STATEMENT 300 CHECKS TO SEE THAT WE ARE NOT OFF THE END OF THE ISAVE
C-VECTOR.  IF NOT, DO ANOTHER K-BANDS    SPECTRUM WITH NEW ISAVE VECTOR
C-VALUES.  IF WE ARE OFF THE END, COMPUTE A NEW FULL SPECTRUM USING A
C-K-VARIATE MODEL.  ALSO CHECK FOR VALUES OF ISAVE EQUAL TO EACH OTHER.
C-IF WE HAVE JUST MOVED INTO A ANOTHER PEAK, REDUCE NPEAK BY ONE AND
C-PACK THE VECTOR DOWN AND START PROCESS OVER AT LPEAK=1.
C
  300 IF (LPEAK-NPEAK) 320,320,310
  320 IF (LPEAK-1) 322,322,321
  321 IF (ISAVE(LPEAK)-ISAVE(LPEAK-1)) 322,323,322
  322 IF (LPEAK-NPEAK) 324,210,324
  324 IF (ISAVE(LPEAK)-ISAVE(LPEAK+1)) 210,325,210
  323 DO 330 LL=LPEAK,NPEAK
  330 ISAVE(LL-1)=ISAVE(LL)
      NPEAK=NPEAK-1
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
  325 NPEAK=NPEAK-1
      DO 331 LL=LPEAK,NPEAK
  331 ISAVE(LL)=ISAVE(LL+1)
```

```
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A BRANCH TO 310 OCCURS WHEN OPTIMIZATION OF THE K-BANDS MODEL IS
C-COMPLETE.  NOW COMPUTE A FULL SPECTRUM USING THE OPTIMIZED K-BANDS
C-MODEL.  SEARCH NEW K-B SPECTRUM FOR PEAKS AND SEE IF ANY NEW ONES TUR-
C-NED UP.  IF SO, GO THRU WHOLE OPTIMIZATION ROUTINE AGAIN.
C
  310 IF (JPRINT-3)360,361,361
  361 WRITE (KPRINT,9)
    9 FORMAT('1COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL')
      IF (JDOMAN)362,362,363
  362 DO 364 LO=1,NPEAK
      KK=ISAVE(LO)
  364 WRITE (KPRINT,8) BANDS(KK)
      GO TO 360
  363 DO 366 LO=1,NPEAK
      KK=ISAVE(LO)
  366 WRITE (KPRINT,8) BAN(KK)
  360 CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      KOUNT=KOUNT+1
      IF (KOUNT-KTOP) 384,384,385
  385 WRITE (KPRINT,386)
  386 FORMAT('1THE PROGRAM IS PROBABLY CAUGHT IN A LOOP.  TRY DIFFERENT
     1INPUT PARAMETERS AND SUBMIT AGAIN')
      GO TO 2000
  384 CALL PPIKR(B,T,ISAVE,NPEEK,NBANDS,SIGLEV)
      IF (NPEAK-NPEEK) 311,350,311
  311 NPEAK=NPEEK
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A STABLE STATE IN THE OPTIMIZING ROUTINE RESUTS IN A BRANCH TO 350.
C-OUTPUT RESULTS.-
C
  350 WRITE (KPRINT,67)
   67 FORMAT('0 M U L T I P L E    B A N D    S P E C T R U M')
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      WRITE (KPRINT,6) RSQ
C
C-CHECK FINAL SPECTRUM FOR EXCESSIVE TOTAL POWER IN SIGNIFICANT BANDS.
C
      CALL TOTAM(X,NOBS,NPEAK,ISAVE,M,PHASE,B,SUMB)
      IF(SUMB-TOPP) 381,382,382
  382 WRITE (KPRINT,383)
  383 FORMAT('1PROGRAM FAILED BY FINDING TOO MUCH POWER IN THE SPECTRUM.
     1',/,'  SUGGEST ALTERING PARAMETERS OF THE ANALYSIS, SUCH AS',/,
     2'   USE WIDER SPECTRUM LIMITS, FILTER DATA, ALTER DELTAP, ETC.')
  381 GO TO 2000
C
```

```
C
C*********************************************************************
C*********************************************************************
C
C
C-STATEMENTS 400-600 INVOLVE COMPUTATION OF THE SIMPLE, SINGLE BAND
C-SPECTRUM ONLY.
C
  400 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS,
     1 AMNAME,TNAME,PHNAME,XNAME,JOOMAN,BANAME)
      GO TO 2000
C
C
C*********************************************************************
C*********************************************************************
C
C
C-STATEMENTS 600-800 INVOLVE COMPUTATION OF A SPECIFIC K-BAND MODEL
C-WITHOUT OPTIMIZATION.
C
C-FIRST READ IN MODEL PARAMETERS, BUILD VECTOR OF BANDS IN MODEL, THEN
C-COMPUTE SPECTRUM.
C
  600 READ (KREADR,1) NPEAK
      READ (KREADR,2) (PEAKS(LPEAK),LPEAK=1,NPEAK)
      DO 610 LPEAK=1,NPEAK
      DO 620 LBAND=1,NBAND
      IF (PEAKS(LPEAK)-BANDS(LBAND)) 620,630,620
  630 ISAVE(LPEAK)=LBAND
      GO TO 610
  620 CONTINUE
  610 CONTINUE
      CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      WRITE (KPRINT,5)
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,ANAME,TNAME,PHNAME,
     1 BANAME,XNAME,JPRINT,JPLOT,JOOMAN)
      WRITE (KPRINT,6) RSQ
 2000 STOP
      END
```

```
C
C
      SUBROUTINE REV(X,N)
      DIMENSION X(50)
C
C **********************************************************************
C *                                                                    *
C *     SUBROUTINE R E V                                               *
C *                                                                    *
C *   REV TAKES A VECTOR AND REVERSES ITS ORDER.                       *
C *                                                                    *
C **********************************************************************
C
      J=N+1
      MID=N/2
      DO 10 L=1,MID
      J=J-1
      SAVE=X(L)
      X(L)=X(J)
   10 X(J)=SAVE
      RETURN
      END
```

```
C
C
      SUBROUTINE PREGEN(X,BANDS,NOBS,NBANDS)
      DIMENSION X(1),BANDS(1)
C
C ********************************************************************
C *                                                                  *
C *   SUBROUTINE  P R E G E N
C *                                                                  *
C *  PREGEN GENERATES THE SINE AND COSINE PREDICTOR WAVES AND STORES *
C *  THEM IN MATRIX X.  MATRIX X IS THE DATA MATRIX HAVING NOBS ROWS *
C *  AND M COLUMNS.  HERE NOBS= THE NUMBER OF OBSERVATIONS AND       *
C *  BANDS IS A VECTOR OF PERIOD VALUES IN THE SPECTRUM.             *
C *                                                                  *
C *  MATRIX X IS STORED IN VECTOR MODE.   SEE IBM SYSTEM/360 SUB-    *
C *  ROUTINE PACKAGE (360A-CM-03X) VERSION III, PROGRAMMER'S MANUAL, *
C *  PUBLICATION NUMBER H20-0205-3, PAGES 3-6.  ESSENTIALLY EACH COL- *
C *  UMN OF MATRIX X IS STRUNG END-TO-END INTO ONE LONG VECTOR.      *
C *                                                                  *
C *  THE FIRST NOBS VALUES OF VECTOR (MATRIX) X WILL BE THE DEPENDENT *
C *  VARIABLE (SEE SUBROUTINE DEPVAR).  THE NEXT NOBS POINTS (COLUMN *
C *  TWO) WILL CONTAIN COS WAVE, BAND 1, THE NEXT NOBS POINTS (COLUMN *
C *  THREE CONTAINS SIN WAVE, BAND 1, ETC.                           *
C *                                                                  *
C ********************************************************************
C
C-CONVERT TO RADIANS/OBSERVATION AND LOOP THRU NBANDS TIMES.
C
      L=NOBS
      DO 10 LBAND=1,NBANDS
      AFREQ=6.28318/BANDS(LBAND)
      EF=-AFREQ
      DO 20 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   20 X(L)=COS(EF)
      EF=-AFREQ
      DO 10 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   10 X(L)=SIN(EF)
C
C-X CONTAINS THE VECTORS OF SIN/COS WAVES STRUNG END-TO-END.  THIS IS
C-EQUIVALENT TO A MATRIX WHERE EACH SIN OR COS WAVE FORMS A COLUMN OF
C-NOBS LENGTH.
C
      RETURN
      END
```

```
C
C
      SUBROUTINE DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
      DIMENSION X(1)
      COMMON KREADR
C
C **********************************************************************
C *                                                                    *
C *   SUBROUTINE  D E P V A R
C *                                                                    *
C *  DEPVAR EITHER READS IN OR GENERATES (VIA SIMULA), A DEPENDENT     *
C *  VARIABLE VECTOR OF LENGTH NOBS.  THE DEPENDENT VARIABLE IS STORED*
C *  INTO THE FIRST NOBS CELLS OF X, A MATRIX OF VARIABLES STORED AS A*
C *  VECTOR OF COLUMNS.  SEE SUBROUTINE PREGEN FOR REST OF X.          *
C *                                                                    *
C **********************************************************************
C
C-IF JDATA IS 0 - READ FROM CARDS, (10X,7F10.0)
C-IF JDATA IS 1 - CALL SIMULA WHICH GENERATES DATA USING A MONTE CARLO
C-SYSTEM ALONG WITH DETERMINISTIC DATA.  SIMULA READS CARDS.
C
      IF (JDATA) 10,10,50
   10 READ (KREADR,1) (X(L),L=1,NOBS)
    1 FORMAT (10X,7F10.0)
      GO TO 20
   50 CALL SIMULA(X,NOBS,JDATA,JDOMAN,JPRINT)
   20 RETURN
      END
```

```
C
C
      SUBROUTINE SIMULA(X,N,J,JDOMAN,JPRINT)
      DIMENSION X(1),A(130),BAND(1)
      COMMON KREADR,KPRINT
C
C ********************************************************************
C *                                                                  *
C *   SUBROUTINE S I M U L A                                         *
C *                                                                  *
C *  SIMULA IS A PRIMATIVE MONTE CARLO AND SIGNAL GENERATOR FOR CREAT-*
C *  ING ARTIFICIAL DATA.  GAUSSIAN DATA ARE READ IN FROM CARDS AND  *
C *  A NUMBER OF SINE WAVES OF VARIABLE FREQUENCY AND AMPLITUDE ARE  *
C *  ADDED.                                                          *
C *                                                                  *
C ********************************************************************
C
C-ZERO VECTOR X AND PRINT HEADING
C
      DO 100 L=1,N
  100 X(L)=0.0
      IF (JPRINT) 110,110,120
  120 WRITE (KPRINT,121)
  121 FORMAT('1M O N T E    C A R L O    SIMULATED DATA',/,'0')
C
C-READ IN MODEL SPECIFICATIONS - GENERATE SINES AND ADD NOISE
C  NSIN-NUMBER OF SINE WAVES IN DATA
C  BAMD-FREQ. OR PERIOD OF THE LSINTH SINE WAVE
C  SD-STANDARD DEFIATION OF THE LSINTH SINE WAVE.  (AMPLITUDE)
C  SDN-STANDARD DEV. OF GAUSSIAN NOISE
C
  110 READ (KREADR,1) NSIN
    1 FORMAT (I5)
      DO 10 LSIN=1,NSIN
      READ (KREADR,2) BAND(1),SD
    2 FORMAT (2F10.0)
      IF (JDOMAN)20,20,30
   30 BAN=BAND(1)
      BAND(1)=1.0/BAND(1)
      GO TO 21
   20 BAN=1.0/BAND(1)
   21 IF (JPRINT) 25,25,22
   22 WRITE (KPRINT,3) LSIN, BAND(1), BAN,SD
    3 FORMAT(' BAND',I3,' - PERIOD=',F10.4,', FREQUENCY=',F10.4,', AMPLI
     1TUDE=',F10.4)
   25 AFREQ=6.28318/BAND(1)
      EF=-AFREQ
      DO 26 L=1,N
      EF=EF+AFREQ
   26 A(L)=SIN(EF)*1.41421
      DO 10 L=1,N
   10 X(L)=X(L)+A(L)*SD
C
C-READ IN NOISE SD AND NOISE CARDS
```

```
C
      READ (KREADR,2) SDN
      IF(SDN) 1000,1000,40
   40 IF (JPRINT) 50,50,41
   41 WRITE (KPRINT,5) SDN
    5 FORMAT('0RANDOM GAUSSIAN NOISE AMPLITUDE=',F10.4)
   50 READ (KREADR,6) (A(L),L=1,N)
    6 FORMAT(4X,10F6.4)
      DO 60 L=1,N
   60 X(L)=A(L)*SDN+X(L)
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE MATPRT(R,M,LVAR)
      DIMENSION R(1),X(15),LVAR(1)
      COMMON KREADR, KPRINT
C
C ***********************************************************************
C *                                                                     *
C *   SUBROUTINE M A T P R T                                            *
C *                                                                     *
C *  MATPRT PRINTS OUT THE LOWER TRIANGULAR MATRIX X WHERE X IS STOR-   *
C *  ED IN MODE 1.  SEE REFERENCE LISTED IN SUBROUTINE PREGEN.          *
C *                                                                     *
C ***********************************************************************
C
C-LOOP THRU AS MANY TIMES AS NEEDED TO PRINT WHOLE MATRIX, EACH TIME
C-PRINTING 15 COLUMNS BY NRO ROWS.
C
      N1=1
      N2=15
  110 IF (N2-M) 100,100,10
   10 N2=M
  100 WRITE (KPRINT,1)  (LVAR(LV),LV=N1,N2)
    1 FORMAT('0',2X,15I7)
      WRITE (KPRINT,2)
    2 FORMAT('0')
C
C-PRINT ONE ROW AT A TIME.  MATRIX R IS MODE 1, UPPER TRIANGULAR.
C-THEREFORE REVERSE SUBSCRIPTS TO MAKE LOWER TRIANGULAR.
C
      DO 20 LROW=N1,M
      IF (LROW-N2) 21,21,22
   21 LIMIT=LROW
      GO TO 23
   22 LIMIT=N2
   23 L=0
      DO 30 LCOL=N1,LIMIT
      L=L+1
      CALL LOC(LCOL,LROW,K,M,M,1)
   30 X(L)=R(K)
   20 WRITE (KPRINT,3) (LROW,(X(K),K=1,L))
    3 FORMAT(1X,I3,2X,15F7.3)
      N1=N1+15
      N2=N1+14
      IF (M-N1) 1000,110,110
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE USPECT(R,T,N    ,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,
     1 BANDS,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      DIMENSION R(1),T(1),B(1),STD(1),PHASE(1),BAN(1),BANDS(1),AMNAME(1)
     1,TNAME(1),PHNAME(1),XNAME(1),BANAME(1)
      COMMON KREADR,KPRINT
C
C ********************************************************************
C *                                                                  *
C     SUBROUTINE U S P E C T
C *                                                                  *
C *  USPECT COMPUTES THE UNIVARIATE SPECTRUM BY MULTIPLYING THE CORR- *
C *  ELATION OF THE TIME SERIES WITH A SIN OR COS PREDICTOR BY THE   *
C *  RATIO OF STANDARD DEVIATIONS OF THE TWO.  THIS IS DONE FOR EACH *
C *  PREDICTOR.  LET R=THE CORRELATION OF F(T) WITH A SIN OR COS WAVE *
C *  OF SOME ARBITRARY WAVE LENGTH.  LET   S =THE STANDARD DEVIATION *
C *  OF THE TIME SERIES AND .707=THE STANDARD DEVIATION OF THE PRED- *
C *  ICTOR WAVE.   THEN  A(F) = R*(S/.707)                           *
C *  WHERE A(F)=THE AMPLITUDE OF THE COMPLEX SPECTRUM AT F.  THE SIN *
C *  AND COS COMPONENTS ARE COMBINED AT EACH WAVE LENGTH AND PHASE   *
C *  ANGLE IS COMPUTED.  T-VALUES ARE ALSO COMPUTED FOR EACH BAND.   *
C *  R=UPPER TRIANGULAR CORRELATION MATRIX, IN STORAGE MODE 1.  SEE  *
C *  IBM PUBLICATION REFERENCED IN SUBROUTINE PREGEN.   (INPUT)      *
C *  T=VECTOR OF T-VALUES.   (OUTPUT)                                *
C *  NOBS=NUMBER OF OBSERVATIONS.   (INPUT)                          *
C *  M=TOTAL NUMBER OF DATA VECTORS.  M=NBANDS*2 + 1.  ONE VECTOR FOR *
C *  THE DEPENDENT VARIABLE AND TWO FOR THE SIN/COS WAVES AT EACH WAVE*
C *  LENGTH.   (INPUT).   B=VECTOR OF SPECTRUM ESTIMATES.   (OUTPUT)  *
C *  NBANDS=LENGTH OF VECTORS T,B AND PHASE.   (INPUT)               *
C *  STD=STANDARD DEVIATIONS OF ALL VARIABLES.   (INPUT)             *
C *  JPRINT=PRINT CONTROL - SEE MAINLINE.   (INPUT)                  *
C *  JPLOT=PLOT CONTROL - SEE MAINLINE.   (INPUT)                    *
C *  PHASE=VECTOR OF PHASE ANGLES.   (OUTPUT)                        *
C *                                                                  *
C ********************************************************************
      LBAND=0
C
C-EXTRACT VECTOR OF CORRELATIONS BETWEEN DEPENDENT VARIABLE AND EACH
C-PREDICTOR VARIABLE.
C
      DO 10 L=2,M
      CALL LOC(1,L,KOOL,M,M,1)
   10 B(L)=R(KOOL)
C
C-LOOP THRU THE SPECTRUM COMPUTATION NBAND TIMES.
C
      FACT=SQRT(FLOAT(N-2))
      DO 20 L=2,M,2
      K=L+1
      LBAND=LBAND+1
C
C-CO=COS COMPONENT OF SPECTRUM ESTIMATE
C-SI=SIN COMPONENT OF SPECTRUM ESTIMATE
```

```
C-TC=T-VALUE FOR COS COMPONENT
C-TS=T-VALUE FOR SIN COMPONENT
C
      CO=B(L)*STD(1)/.707
      SI=B(K)*STD(1)/.707
      TC=B(L)*FACT/SQRT(1.0-B(L)**2)
      TS=B(K)*FACT/SQRT(1.0-B(K)**2)
C
C-COMPUTE SPECTRUM AMPLITUDE, T-VALUE AND PHASE ANGLE
C
      B(LBAND)=SQRT(CO**2 + SI**2)
      T(LBAND)=SQRT(TC**2 + TS**2)
   20 PHASE(LBAND)=ATAN(CO/SI)
C
C-PRINT AND/OR PLOT IF DESIRED
C
      JPR=JPRINT-1
      JPL=JPLOT-1
      IF (JPR) 50,50,60
   50 IF (JPL) 1000,1000,60
   60 WRITE(KPRINT,1)
    1 FORMAT('O S I N G L E    B A N D    S P E C T R U M')
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME
     1,BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      DIMENSION B(1),T(1),ISAVE(1)
C
C ********************************************************************
C *                                                                  *
C *     SUBROUTINE P P I K R                                         *
C *                                                                  *
C *   PPIKR RETURNS THE VECTOR INDEX OF ALL SIGNIFICANT SPECTRUM PEAKS.*
C *   B-INPUT VECTOR OF AMPLITUDE SPECTRUM ESTIMATES                 *
C *   T-INPUT VECTOR OF T-VALUES FOR EACH SPECTRUM ESTIMATE          *
C *   ISAVE-OUTPUT VECTOR OF INDEX NUMBERS OF SIGNIFICANT PEAKS      *
C *   NPEAK-OUTPUT SCALAR - NUMBER OF PEAKS FOUND                    *
C *   NBANDS-INPUT SCALAR - NUMBER OF BANDS IN SPECTRUM              *
C *   SIGLEV-INPUT SCALAR - CRITERION WHICH T-VALUE FOR A PEAK MUST  *
C *           EXCEED IN ORDER TO BE RETAINED                         *
C *                                                                  *
C ********************************************************************
C
C-SEARCH FOR PEAKS, RETAIN 'SIGNIFICANT' ONES, BUILD ISAVE.
C
      NPEAK=0
      DO 10 L=2,NBANDS
      IF (B(L-1)-B(L)) 20,10,10
   20 IF (B(L+1)-B(L)) 40,10,10
   40 IF (T(L)-SIGLEV) 10,50,50
   50 NPEAK=NPEAK+1
      ISAVE(NPEAK)=L
   10 CONTINUE
      RETURN
      END
```

```
C
C
      FUNCTION CRITR(RSQ,T,JCRITR,L)
      DIMENSION T(1)
C
C *****************************************************************
C *                                                               *
C *   FUNCTION C R I T R                                          *
C *                                                               *
C *  CRITR SELECTS A CRITERION FOR THE SPECTRUM OPTIMIZATION BY PEAK *
C *  SHIFTING.  SELECTS EITHER R-SQUARE OR THE APPROPRIATE T VALUE.  *
C *                                                               *
C *****************************************************************
C
C-SELECT APPROPRIATE VALUE FOR CRITERION.
C  RSQ-INPUT SCALAR - VALUE OF R-SQUARE
C  T-INPUT VECTOR - T-VALUES
C  JCRITR-CONTROL DIGIT FOR SELECTION OF EITHER RSQ OR T(L) AS CRITERION
C          0=RSQ AS CRITERION
C          1=T-VALUE AS CRITERION
C  L-INDEX VALUE OF VECTOR T
C
      IF (JCRITR) 10,10,20
   10 CRITR=RSQ
      GO TO 30
   20 CRITR=T(L)
   30 RETURN
      END
```

```
C
C
      SUBROUTINE KSPECT(R,T,N,M,NPEAK,ISAV ,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE, BANDS,BAN)
      DIMENSION ISAVE(100)    ,R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),
     1PHASE(1),BANDS(1),BAN(1)                    ,ANS(10),ISAV(1),RY(100)
      COMMON KREADR,KPRINT
C-CONVERT ISAV TO ISAVE, FROM FREQ BAND VECTOR TO VECTOR OF SIN/COS PAIR
C
98521 FORMAT ('0JKL=',I5)
      K=0
      DO 100 L=1,NPEAK
      K=K+1
      ISAVE(K)=ISAV(L)*2
      K=K+1
  100 ISAVE(K)=ISAVE(K-1)+1
C
C-SELECT SUB-MATRIX OF PREDICTORS ETC FROM R, ACCORDING TO ISAVE.
C
      CALL ORDER(M,R,1,K     ,ISAVE,RX,RY)
C
C-INVERT K-ORDER MATRIX OF PREDICTOR INTERCORRELATIONS, RX
C
      CALL MINV(RX,K,DET,B,T)
      IF (JPRINT-3) 300,400,400
  400 WRITE (KPRINT,7) DET
    7 FORMAT('0',/,'0 DETERMINANT =',E30.15)
C
C-COMPUTE REGRESSIONS(SPECTRUM) FOR NPEAK SIZED MODEL.
C
  300 CALL MULTR(N,K,XBAR,STD,D,RX,RY,ISAVE,B,SB,T,ANS)
      RSQ=ANS(2)**2
C
C-CONVERT SPECTRUM TO AMPLITUDES BY COMBINING SIN/COS.  PUT INTO D.
C-ALSO CONVERT T.
C
      NFREQ=0
      DO 200 L=1,K,2
      NFREQ=NFREQ+1
      PHASE(NFREQ)=ATAN(B(L)/B(L+1))
      B(NFREQ)=SQRT(B(L)**2 + B(L+1)**2)
  200 T(NFREQ)=SQRT(T(L)**2 + T(L+1)**2)
   10 RETURN
      END
```

```
C
C
      SUBROUTINE MULTI(ISAVE,NPEAK,NBANDS,R,T,N,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      DIMENSION ISAVE(1),R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),PHASE
     1 (1),BANDS(1),BAN(1),KSAVE(20),S(20),TSPEC(20),TPH(20)
      COMMON KREADR,KPRINT
C
C *******************************************************************
C *                                                                 *
C *   SUBROUTINE M U L T I                                          *
C *                                                                 *
C *  MULTI COMPUTES THE FULL SPECTRUM OF A TIME SERIES USING A K+1  *
C *  BANDS    MODEL WHERE K=THE NUMBER OF PEAKS IN THE OPTOMIZED    *
C *  MODEL.  THE EXTRA BAND IS THE WAVELENGTH IN QUESTION. THE OTHERS *
C *  ARE THE SIGNIFICANT PEAKS.  THE VARIANCE ACCOUNTED FOR BY      *
C *  THE SIGNIFICANT PEAKS IS THUS 'ACCOUNTED FOR' IN EACH ESTIMATE. *
C *  WHEN THE CURRENT BAND IS ONE OF THE SIGNIFICANT PEAKS, A SKIP  *
C *  OCCURS.  VARIABLES DEFINED IN MAINLINE.                        *
C *                                                                 *
C *******************************************************************
C
C
C-LOOP THRU ONCE FOR EACH FREQ BAND.  NFMOD IS THE NUMBER OF SIGNICIC-
C-CANT PEAKS IN MODEL PLUS A CURRENT BAND.
C
      NFMOD=NPEAK+1
      DO 310 LF=1,NBANDS
C
C-CONSTRUCT NEW ISAVE VECTOR
C
      CALL BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
C
C-SKIP IF THIS BAND IS IN THE MODEL ALREADY
C
      IF (ISKIP) 320,320,330
C
C-BRANCH TO 330 IMPLIES THAT THE CURRENT BAND IS ONE OF THE SIGNIFICANT
C-PEAKS.  DO AN NPEAK SPECTRUM AND PICK OUT CURRENT BAND.
C
  330 CALLKSPECT(R,S,N,M,NPEAK,ISAVE,RX,TSPEC,0,XBAR,STD,D,RSQ,TPH,
     1BANDS,BAN)
C
C-TSPEC CONTAINS ALL MODEL ESTIMATES.  PICK THE ONE FOR LF.
C
      DO 331 LLZ=1,NPEAK
      IF (LF-ISAVE(LLZ)) 331,333,331
  333 B(LF)=TSPEC(LLZ)
      PHASE (LF)=TPH(LLZ)
      T(LF)=S(LLZ)
  331 CONTINUE
      GO TO 310
C
C-BRANCH TO 320 IMPLIES THAT THIS IS A FULL NFMOD MODEL.  DO SPECTRUM
```

```
C-AND PICK OUT CURRENT BAND.
C
  320 CALLKSPECT(R,S,N,H,NFMOD,KSAVE,RX,TSPEC,0,XBAR,STD,D,RSQ,TPH,
     1 BANDS,BAN)
      DO 321 LLL=1,NFMOD
      IF(LF-KSAVE(LLL)) 321,322,321
  322 T(LF)=S(LLL)
      B(LF)=TSPEC(LLL)
      PHASE (LF)=TPH(LLL)
  321 CONTINUE
  310 CONTINUE
      RETURN
      END
```

```
C
C
      SUBROUTINE BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
      DIMENSION KSAVE(1),ISAVE(1),ASAVE(30),RANC(30)
C
C ********************************************************************
C *                                                                  *
C     SUBROUTINE B U I L D
C *   BUILD CONSTRUCTS VECTOR OF RANKED FREQ BAND NUMBERS GIVEN A    *
C *   PARTICULAR MODEL AND A CURRENT FREQUENCY.                      *
C *   KSAVE - OUTPUT VECTOR TO BE BUILT                              *
C *   ISAVE - INPUT VECTOR CONTAINING NFREQ SIGNIF PEAKS             *
C *   LF - INPUT SCALAR - NEW FREQ BAND TO BE ADDED (CURRENT ONE)    *
C *   NFMOD - INPUT - NUMBER OF FREQ BANDS IN NEW MODEL              *
C *   ISKIP - OUTPUT CONTROL DIGIT TO KEEP FROM COMPUTING ESTIMATE   *
C *            OF ONE OF THE OLD PEAKS AGAIN                         *
C *   NPEAK - INPUT - NUMBER OF FREQ BANDS IN OLD MODEL              *
C *                                                                  *
C ********************************************************************
C
C-SEE IF LF IS ALREADY IN MODEL
C
      DO 10 L=1,NPEAK
      IF(LF - ISAVE(L)) 10,99,10
   10 CONTINUE
C
C-STORE VECTOR OF ISAVE PLUS LF INTO ASAVE AND RANK IT.  RANK STORED IN
C-VECTOR RANC
C
      DO 20 L=1,NPEAK
   20 ASAVE(L)=ISAVE(L)
      ASAVE(NFMOD)=LF
      CALL RANK(ASAVE,RANC,NFMOD)
C
C-BUILD KSAVE OF RANKED FREQ BANDS
C
      DO 30 L=1,NFMOD
      KOOL=RANC(L)
   30 KSAVE(KOOL)=ASAVE(L)
      ISKIP=0
      GO TO 100
   99 ISKIP=1
  100 RETURN
      END
```

```
C
C
      SUBROUTINE OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      DIMENSION BANDS(1),BAN(1),B(1),T(1),PHASE(1),AMNAME(1),TNAME(1),
     1PHNAME(1),BANAME(1),XNAME(1)
      COMMON KREADR,KPRINT
C
C *******************************************************************
C *                                                                 *
C *   SUBROUTINE O U T P U T                                        *
C *                                                                 *
C *  OUTPUT PRINTS AND/OR PLOTS SPECTRA WITH DOCUMENTATION.         *
C *                                                                 *
C *******************************************************************
C
C-PRINT OUT DOCUMENTATION AND VECTOR ORDER IN APPROPRIATE DOMAIN)
C-FIND SCALE VALUES AND PLOT
C
      TOPI=6.28318
      BTOPI=-TOPI
      BMAX=B(1)
      DO 64 LBAND=2,NBANDS
      IF (BMAX-B(LBAND)) 68,64,64
   68 BMAX=B(LBAND)
   64 CONTINUE
      TMAX=T(1)
      DO 66 LBAND=2,NBANDS
      IF (TMAX-T(LBAND)) 67,66,66
   67 TMAX=T(LBAND)
   66 CONTINUE
      IF (JDOMAN) 60,60,50
C
C-REVERSE VECTORS IF FREQ DOMAIN IS USED - PRINT - REVERSE AGAIN.
C
   50 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      IF (JPRINT) 52,52,51
   51 WRITE (KPRINT,2)
    2 FORMAT('OFREQUENCY ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 55 LBAND=1,NBANDS
   55 WRITE (KPRINT,3) BAN(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
    3 FORMAT(F10.3,5X,F9.3,5X,F7.3,5X,F8.3)
   52 IF (JPLOT) 54,54,53
   53 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BAN,AMNAME,TNAME,BANAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BAN,PHNAME,TNAME,
     1 BANAME)
   54 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      GO TO 100
   60 IF (JPRINT) 62,62,61
   61 WRITE (KPRINT,4)
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    4 FORMAT('OPERIOD     ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 65 LBAND=1,NBANDS
   65 WRITE (KPRINT,3) BANDS(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
   62 IF (JPLOT) 100,100,63
   63 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BANDS,AMNAME,TNAME,XNAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BANDS,PHNAME,TNAME,
     1 XNAME)
  100 RETURN
      END
```

```
C
C
      SUBROUTINE PLOT2(Y1,YMAX1,YMIN1,Y2,YMAX2,YMIN2,NP,XAX,YNAM1,
     1 YNAM2,XNAM)
      DIMENSION Y1(1),Y2(1),LINE(111),XAX(1),XNAM(5),YNAM1(9),YNAM2(9)
      COMMON KREADR,KPRNT
      DATA KBLNK/' '/,KBORD/'.'/,KAL/'+'/,KPLOT/'*'/
C
C--PLOT2 GENERATES TWO OVER/UNDER     GRAPHS PER PAGE AND CALIBRATES
C--THEM. Y1=VERTICAL VARIABLE 1, YMAX1, YMIN1=VERTICAL PLOT LIMITS.
C--Y2, YMAX2, YMIN2=SIMILAR FOR SECON VARIABLE, NP=NUMBER OF POINTS,
C--XAX=X AXIS (COMMON TO BOTH VARIABLES).
      WRITE (KPRNT,2)       YNAM1,YNAM2,XNAM
    2 FORMAT('1'       / T5,'*'/ T5,'*',T25,'*',T80,'*'/ T5,'*',T25,'***'
     1,T80,'***'/ T3,'*****',T18,'************ ',9A4,T73,'************ '
     2,9A4/T4,'***',T25, '***', T80,'***'/T5,'*',T25,'*',T80,'*'/1X,5A4)
C
C--GENERATE SCALE FACTORS
      SKAL1=50.5/(YMAX1-YMIN1)
      SKAL2=50.5/(YMAX2-YMIN2)
C--GENERATE CALIBRATION AND OUTPUT IT.
      CAL01 = YMIN1
      CAL02 = YMIN2
      CAL1 = YMAX1
      CAL2 = YMAX2
      CAL51=YMAX1-(.5*(YMAX1-YMIN1))
      CAL52=YMAX2-(.5*(YMAX2-YMIN2))
      WRITE (KPRNT,1) CAL01,CAL51,CAL1,CAL02,CAL52,CAL2
    1 FORMAT (' ',F14.4,F24.4,F23.4,F12.4,F23.4,F24.4)
C--GENERATE VERTICAL AXIS AND OUTPUT IT
      DO 10 L = 1,111
   10 LINE(L) = KBORD
      LINE(1) = KAL
      LINE(26) = KAL
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
      DO 20 L=52,60
   20 LINE(L) = KBLNK
      WRITE(KPRNT,4) LINE
    4 FORMAT(10X,111A1)
C
C--DECIDE HOW MANY LINES BETWEEN POINTS
      NWIDE = 32/NP
C
C--LOOP FOR NUMBER OF POINTS, EACH TIME PLOTTING A POINT AND NWIDE SPACE
      DO 30 LP = 1, NP
C
C--CLEAR LINE AND GENERATE GRID POINTS
      DO 40 L = 1,111
   40 LINE(L) = KBLNK
      LINE (1)=KBORD
      LINE(26)=KBORD
```

```
      LINE(51)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--TEST FOR OVER OR UNDER RANGE AND TRUNCATE OUT-OF-BOUNDS VALUES
      IF (Y1(LP)-YMAX1) 2000, 2000, 2100
 2100 YA      = YMAX1
      GO TO 5100
 2000 IF(Y1(LP)-YMIN1)5000, 5200, 5200
 5000 YA      = YMIN1
      GO TO 5100
 5200 YA=Y1(LP)
 5100 IF (Y2(LP)-YMAX2) 200, 200, 210
  210 YB      = YMAX2
      GO TJ 510
  200 IF (Y2(LP)-YMIN2) 500, 520, 520
  500 YB      = YMIN2
      GO TO 510
  520 YB=Y2(LP)
C
C--NOW GENERATE POINT INDEXES
  510 K1 = (YA     -YMIN1)*SKAL1+1.0
      K2 = (YB     -YMIN2)*SKAL2+61.0
      LINE(K1)= KPLOT
      LINE(K2)= KPLOT
C
C--OUTPUT HORIZONTAL SCALE VALUE AND LINE
      WRITE (KPRNT ,3) XAX(LP),LINE
    3 FORMAT (1X,F 8.4,1X,111A1)
C
C--CLEAR LINE AND GENERATE BLANK LINES FOR SPACE
      IF (NWIDE) 30,30,110
  110 DO 95 L=1,111
   95 LINE(L)=KBLNK
      LINE (1)=KBORD
      LINE(51)=KBORD
      LINE(26)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--OUTPUT PLAIN LINE
      DO 90 LOOP=1,NWIDE
   90 WRITE (KPRNT,4) LINE
   30 CONTINUE
C
C--GENERATE RIGHT BORDER AND OUTPUT
      DO 50 L = 1,111
   50 LINE(L) = KBORD
      LINE(1) = KAL
      [illegible]
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
```

```
      DO 80 L= 52,60                                                    PLT21110
   80 LINE (L) = KBLNK                                                  PLT21120
      WRITE (KPRNT,4) LINE                                              PLT21130
      RETURN                                                            PLT21140
      END                                                               PLT21150
```

```
C
C
      SUBROUTINE TOTAM(X,N,NPEAK,ISAVE,M,PHASE,B,AMP)
      DIMENSION X(1),ISAVE(1),PHASE(1),B(1)
C
C *******************************************************************
C *                                                                 *
C *    SUBROUTINE  T O T A M                                        *
C *                                                                 *
C *    TOTAM COMPUTES THE RESULTANT AMPLITUDE OF THE SUM OF NPEAK SIN- *
C *    SOIDS WHICH HAVE THEIR AMPLITUDES AND PHASES DETREMINED BY THE *
C *    CALLING PROGRAM..  TOTAM SIMPLY SELECTS THE APPROPRIATE SINE *
C *    AND COSINE WAVES FROM X, WEIGHTS THEM, SUMS THEM AND THEN COM- *
C *    PUTES THE AMPLITUDE OF THE SUM.                              *
C *    W A R N I N G    -------    THIS WILL DESTROY ROW 1 OF X WHICH *
C *    CONTAINS THE ORIGINAL DEPENDENT VARIABLE.                    *
C *                                                                 *
C *******************************************************************
C
C-LOOP THRU THE FOLLOWING NPEAK TIMES TO CREATE THE RESULTANT WAVE INX
C
      DO 100 LP=1,NPEAK
      K=ISAVE(LP)
      KC=K*2
      KS=KC+1
C
C-THE FOLLOWING COMPUTES THE PROPER AMPLITUDES FOR THE COSINE AND SINE
C-COMPONENTS, BASED ON PHASE AND AMPLITUDE ESTIMATES.
C
      PC=1.0
      PC=PC/(TAN(PHASE(K))+ PC)
      PS=PC*TAN(PHASE(K))
C
C-SELECT SINE AND COSIND VALUES FROM X A
C-SELECT SINE AND COSINE VALUES FROM X, SUM AND PUT INTO X, ROW 1.
C
      DO 100 L=1,N
      CALL LOC(KC,L,J,M,N,0)
      CALL LOC(KS,L,I,M,N,0)
  100 X(L)=X(J)*PC + X(I)*PS
C
C-COMPUTE APLLITUDE OF RESULTANT
C
      SX=0.0
      DO 10 L=1,N
   10 SX=SX+X(L)
      SX=SX/FLOAT(N)
      SXS=0.0
      DO 20 L=1,N
   20 SXS=SXS+(X(L)-SX)**2
      AMP=SQRT(SXS/FL[illegible]
      RETURN
      END
```

```
      SUBROUTINE DATA
      RETURN
      END
```

U S E   O F   S P E C T

THE FOLLOWING IS A LIST OF INPUT PARAMETERS AND DATA CARDS AND THEIR INTERPRETATIONS.

```
JDOMAN-DOMAIN OF ANALYSIS.  0 OR BLANK=PERIOD, 1=FREQUENCY.
JBANDS-HOW VECTOR OF FREQUENCY OR PERIOD BANDS WILL BE OBTAINED.
        0 OR BLANK=GENERATE ACCORDING TO LIMITS SUBSEQUENTLY READ IN.
        1=READ IN A VECTOR OF BANDS TO BE USED FROM CARDS.
NBANDS-HOW MANY FREQUENCY OR PERIOD BANDS WILL BE USED.
NOBS-THE NUMBER OF OBSERVATIONS IN THE DATA VECTOR
JANALY-HOW THE DATA SHALL BE ANALYZED.
        0 OR BLANK=DO UNIVARIATE SPECTRUM, SEARCH FOR BEST K-VARIATE
                  MODEL
        1=SIMPLY DO UNIVARIATE SPECTRUM
        2=DO K-VARIATE SPECTRUM ACCORDING TO MODEL PARAMETER READ IN
JDATA-TELLS SUBROUTINE DEPVAR WHERE TO GET DATA.
      0 OR BLANK=READ FROM CARDS ACCORDING TO FORMAT (10X,7F10.0)
      1=GENERATE DATA FROM MODELING PROGRAM CALLED BY DATA.  THIS
        MODELING PROGRAM WILL ASK FOR MORE CARDS.
JCRITR-SELECTS CRITERION FOR OPTIMIZATION OF K-VARIATE SPECTRUM.
        0 OR BLANK=MULTIPLE R-SQUARED
        1=T-VALUES
JPRINT-PRINTOUT CONTROL DIGIT
        0=DONT PRINT ANY RESULTS
        1=PRINT ONLY FINAL RESULTS
        2=PRINT FINAL AND INTERMEDIATE RESULTS
        3=PRINT AS FOR 2 PLUS MATRICES, CORRELATIONS,ETC FOR EACH STEP
JPLOT-PLOT CONTROL DIGIT. - VALUES AS ABOVE EXCEPT FOR 3.

BANDLO-LOWEST FREQ. OR LONGEST PERIOD, AS APPROPRIATE TO DOMAIN.
BANDEL-DELTA(FREQ.) OR DELTA(PERIOD), AS APPROPRIATE TO DOMAIN.

BANDS-VECTOR OF BANDS.

NSIN-NUMBER OF SINE WAVES IN SIMULATED DATA.
BAND-FREQ. OR PERIOD OF THE LSINTH SIMULATED SINE WAVE
SD-STANDARD DEVIATION OF THE LSINTH SIMULATED SINE WAVE.  (AMPLITUDE)
SDN-STANDARD DEV. OF GAUSSIAN NOISE
```

```
THE FOLLOWING IS A LIST OF INPUT CARDS AND THEIR CONTENTS

CARD 1 - - - MANDATORY
    COLUMN    VARIABLE    COMMENTS - - -
     1 -  5 -  JDOMAN       RIGHT JUSTIFY
     6 - 10 -  JBANDS       RIGHT JUSTIFY
    11 - 15 -  NBANDS       RIGHT JUSTIFY
    16 - 20 -  NOBS         RIGHT JUSTIFY
    21 - 25 -  JANALY       RIGHT JUSTIFY
    26 - 30 -  JDATA        RIGHT JUSTIFY
    31 - 35 -  JCRITR       RIGHT JUSTIFY
    36 - 40 -  JPRINT       RIGHT JUSTIFY
    41 - 45 -  JPLOT

CARD 2 - - - REQUIRED ONLY IF JBANDS=0, OTHERWISE OMIT.
    COLUMN    VARIABLE    COMMENTS - - -
     1 - 10 -  BANDLO       PUNCH DECIMAL
    11 - 20 -  BANDEL       PUNCH DECIMAL

CARDS 3 - - - REQUIRED ONLY IF JBANDS=1.
    COLUMN    VARIABLE    COMMENTS - - -
     1 - 10 -  BANDS(1)     PUNCH DECIMAL - 1ST BAND IN SPECTRUM.
    11 - 20 -  BANDS(2)     PUNCH DECIMAL - 2ND BAND IN SPECTRUM.
     *
     *
    CONTINUE FOR AS MANY CARDS AS NEEDED TO READ IN NBANDS BANDS.
    FORMAT(8F10.0)

CARDS 4 - - - REQUIRED ONLY IF JDATA=0.
    COLUMN    VARIABLE    COMMENTS - - -
     1 - 10 -  ID CODE      MAY CONTAIN ANYTHING - NOT READ.
    11 - 20 -  DATA(1)      1ST DATA POINT.  PUNCH DECIMAL OR RIGHT JUSTIFY.
    21 - 30 -  DATA(2)      2ND DATA POINT.  PUNCH DECIMAL OR RIGHT JUSTIFY.
     *
     *
    CONTINUE SAME FORMAT ON CARDS AS NEEDED FOR NOBS DATA POINTS.
    FORMAT(10X,7F10.0)

CARDS 5 - - - REQUIRED ONLY IF JDATA=1.
  5A - - MANDATORY.
    COLUMN    VARIABLE    COMMENTS - - -
     1 -  5 -  NSIN         RIGHT JUSTIFY.

  5B - - REQUIRED ONLY IF NSIN IS NOT ZERO.
    COLUMN    VARIABLE    COMMENTS - - -
     1 - 10 -  BAND(1)      PUNCH DECIMAL.
    11 - 20 -  SD(1)        PUNCH DECIMAL.
    CONTINUE SAME FORMAT THRU NSIN CARDS (BANDS).  FORMAT(2F10.0)

  5C - - MANDATORY
    COLUMN    VARIABLE    COMMENTS - - -
     1 - 10 -  SDN          PUNCH DECIMAL

  5D - - REQUIRED ONLY IF SDN IS NOT ZERO
    COLUMN    VARIABLE    COMMENTS - - -
     1 -  4    ID CODE      MAY CONTAIN ANYTHING - NOT READ.
     5 - 10    NOISE(1)     PUNCH DECIMAL.  1ST GAUSSIAN RANDOM NUMBER.
    11 - 16    NOISE(2)     PUNCH DECIMAL.  2ND GAUSSIAN RANDOM NUMBER.
     *
     *
    CONTIN[illegible] AS MANY CARDS AS NEEDED FOR NOBS RANDOM NUMBERS.
    FORMAT(4X,1[illegible].4)
```

```
C
C
C*********************************************************************
C*********************************************************************
C
C
      DIMENSION BANDS( 50),BAN( 50),PEAKS(50),PHASE(50),AMNAME(9),TNAME
     1(9),PHNAME(9),BANAME(5),XNAME(5),LVAR(100),ISAVE(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- NOBS*(NBANDS*2+1)
C
      DIMENSION X(30000)
C
C-THE FOLLOWING DIMENSIONS MUST BE EQUAL TO OR GREATER THAN NBANDS*2+1
C
      DIMENSION XBAR(100),STD(100),B(100),D(100),T(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- M*M, WHERE M=2*NBANDS+1
C
      DIMENSION RX(10000)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN (M+1)*M/2
C
      DIMENSION R(5050)
      COMMON KREADR,KPRINT
      DATA AMNAME/'AMPL','ITUD','E ES','IMAT','E.  ','    ','    ','    ',
     1'    ','    '/
      DATA  TNAME/'T-VA','LUE.','    ','    ','    ','    ','    ','    ',
     1'    ','    '/
      DATA PHNAME/'PHAS','E ES','TIMA','TE. ','    ','    ','    ','    ',
     1'    ','    '/
      DATA BANAME/'FREQ','UENC','Y   ','    ','    '/
      DATA  XNAME/'PERI','OD  ','    ','    ','    '/
      KREADR=5
      KPRINT=6
C
C-READ IN CONTROL DIGITS AS FOLLOWS AND PRINT THEM OUT.
C   JDOMAN-DOMAIN OF ANALYSIS.  0 OR BLANK=PERIOD, 1=FREQUENCY.
C   JBANDS-HOW VECTOR OF FREQUENCY OR PERIOD BANDS WILL BE OBTAINED.
C          0 OR BLANK=GENERATE ACCORDING TO LIMITS SUBSEQUENTLY READ IN.
C          1=READ IN A VECTOR OF BANDS TO BE USED FROM CARDS.
C   NBANDS-HOW MANY FREQUENCY OR PERIOD BANDS WILL BE USED.
C   NOBS-THE NUMBER OF OBSERVATIONS IN THE DATA VECTOR
C   JANALY-HOW THE DATA SHALL BE ANALYZED.
C          0 OR BLANK=DO UNIVARIATE SPECTRUM, SEARCH FOR BEST K-VARIATE
C                     MODEL
C          1=SIMPLY DO UNIVARIATE SPECTRUM
C          2=DO K-VARIATE SPECTRUM ACCORDING TO MODEL PARAMETER READ IN
C   JDATA-TELLS SUBROUTINE DEPVAR WHERE TO GET DATA.
C        0 OR BLANK=READ FROM CARDS ACCORDING TO FORMAT (10X,7F10.0)
C        1=GENERATE DATA FROM MODELING PROGRAM CALLED BY DATA.  THIS
C          MODELING PROGRAM WILL ASK FOR MORE CARDS.
```

```
C  JCRITR-SELECTS CRITERION FOR OPTIMIZATION OF K-VARIATE SPECTRUM.
C          0 OR BLANK=MULTIPLE R-SQUARED
C          1=T-VALUES
C  JPRINT-PRINTOUT CONTROL DIGIT
C          0=DONT PRINT ANY RESULTS
C          1=PRINT ONLY FINAL RESULTS
C          2=PRINT FINAL AND INTERMEDIATE RESULTS
C          3=PRINT AS FOR 2 PLUS MATRICES, CORRELATIONS,ETC FOR EACH STEP
C  JPLOT-PLOT CONTROL DIGIT. - VALUES AS ABOVE EXCEPT FOR 3.
C
      READ (KREADR,1) JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
    1 FORMAT (16I5)
      WRITE (KPRINT,103)
  103 FORMAT ('1 * * * * * * *  PROGRAM PARAMETERS * * * * * * * * *'I
      WRITE (KPRINT,1)JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
C
C-KTOP =MAX NUMBER OF TIMES THE PROGRAM WILL BE ALLOWED TO TRY IMPROVE-
C-MENTS ON THE WHOLE MULTIVARIATE SPECTRUM.  KOUNT IS THE NUMBER OF
C-SUCH TRIES.
C
      KTOP=4
      KOUNT=0
C
C-SET SIGLEV, THE T-VALUE FOR THE CRITERION OF ACCEPTANCE OF A PEAK.
C-THEN DECIDE HOW TO GET VECTOR OF BANDS.
C
      SIGLEV=2.0
      IF (JBANDS) 100,100,110
C
C-READ IN LIMITS OF BANDS VECTOR IF JBANDS WAS 0 - GENERATE BANDS.
C-OTHERWISE GO TO 110 AND READ IN BANDS FROM CARDS.
C  BANDLO-LOWEST FREQ. OR LONGEST PERIOD, AS APPROPRIATE TO DOMAIN.
C  BANDEL-DELTA(FREQ.) OR DELTA(PERIOD), AS APPROPRIATE TO DOMAIN.
C  BANDS-VECTOR OF BANDS.
C
  100 READ (KREADR,2) BANDLO,BANDEL
    2 FORMAT (8F10.0)
      BANDS(1)=BANDLO
      DO 120 LBAND=2,NBANDS
  120 BANDS(LBAND)=BANDS(LBAND-1) + BANDEL
      GO TO 130
  110 READ (KREADR,2) (BANDS(LBAND),LBAND=1,NBANDS)
C
C-CONVERT BANDS TO PERIOD DOMAIN IF ORIGINATED IN FREQ DOMAIN.
C-REVERSE THE ORDER OF BANDS SO AS TO BE IN ASCENDING WAVELENGTH ORDER.
C-ALSO GENERATE BAN, THE FREQ DOMAIN VECTOR OF BANDS.
C
  130 IF (JDOMAN) 150,150,140
  140 DO 141 LBAND=1,NBANDS
      BAN(LBAND)=BANDS(LBAND)
  141 BANDS(LBAND)=1.0/BANDS(LBAND)
      CALL REV(BANDS,NBANDS)
C
C-GENERATE SIN/COS PREDICTOR MATRIX AS PART OF DATA MATRIX, X.  THEN
```

```
C-READ IN DEPENDENT VARIABLE PART OF X.  THESE DATA WILL THEN BE ENT-
C-ERED INTO SUBROUTINE CORRE TO COMPUTE THE CORRELATION MATRIX OF ALL
C-VARIABLES.
C
  150 M=NBANDS*2 + 1
      CALL PREGEN(X,BANDS,NOBS,NBANDS)
      CALL DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
C
C-GENERATE VECTOR OF VARIABLE NUMBERS FOR LATER USE.
C
      DO 155 LV=1,M
  155 LVAR(LV)=LV
      CALL CORRE(NOBS,M,1,X,XBAR,STD,RX,R,B,D,T)
C
C-SET TOPP, THE MAXIMUM ALLOWABLE TOTAL AMPLITUDE IN THE FINAL SPECTRUM
C-TOPP IS THE TOTAL AMPLITUDE OF THE F(T)+25 PERCENT.
C
      TOPP=STD(1)+.25*STD(1)
C
C-PRINT OUT MATRICES ETC., IF DESIRED
C
      IF(JPRINT-3) 151,152,152
  152 WRITE (KPRINT,5)
    5 FORMAT('1M A T R I X   O F   C O R R E L A T I O N S',/,' VARIAB
     1LE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAV
     2ES OF VARIOUS PERIODS ',/,T88,'--------',/,'0')
      CALL MATPRT(R,M,LVAR)
C
C-DECIDE ON PROPER DATA ANALYSIS PATH.
C
  151 JANALY=JANALY+1
      GO TO (200,400,600),JANALY
C
C
C***********************************************************************
C***********************************************************************
C
C
C-STATEMENTS 200-400 INVOLVE COMPUTATION OF OPTIMIZED K-BANDS SPECTRA
C
C-FIRST COMPUTE UNIVARIATE SPECTRUM USING SUBROUTINE USPECT.  THEN FIND
C-ALL SIGNIFICANT SPECTRUM PEAKS IN UNIVARIATE SPECTRUM.
C
  200 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS
     1,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      CALL  PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      IF (NPEAK) 201,201,202
  201 WRITE (KPRINT,66)
   66 FORMAT('0** * *  * NO SIGNIFICANT PEAKS FOUND *  * * **')
      GO TO 2000
C
C-NOW LOOP THRU AN OPTIMIZING PROCESS TRYING TO FIND LARGEST VALUE OF
C-EITHER T OR R-SQUARE.  THE BEGINNING OF THIS LOOP IS STATEMENT 210
C
C-SET A VALUE OF CRIT=0.  THIS WILL LATER BE USED TO STORE THE JUST
C-PRECEDING VALUE OF THE OPTIMIZATION CRITERION.  ALSO INITIALIZE THE
```

```
C-VARIABLE MM =-1.  MM IS THE DIRECTION OF PEAK SLIDING AS WELL AS THE
C-COUNTER FOR THE NUMBER OF STEPS.
C
  202 LPEAK=1
      CRIT=0.0
      MM=0
  210 CALL KSPECT(R,T,NOBS,M,NPEAK,ISAVE,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE,BANDS,BAN)
C
C-TEST FOR PRINTOUT
C
      IF(JPRINT-3)208,209,209
  209 WRITE (KPRINT,6) RSQ
    6 FORMAT ('0MULTIPLE SQUARED CORRELATION=',F8.4)
      WRITE (KPRINT,7)
    7 FORMAT(' PERIOD/FREQ.',T20,'AMPLITUDE',T40,'T-VALUE')
      DO 214 LO=1,NPEAK
      KK=ISAVE(LO)
      IF (JDOMAN) 212,212,213
  212 BB=BANDS(KK)
      GO TO 214
  213 BB=BAN(KK)
  214 WRITE (KPRINT,8) BB,B(KK),T(KK)
    8 FORMAT (2F12.4,F18.4)
C
C-SELECT CRITERION FOR GOODNESS OF FIT - CHECK FOR IMPROVEMENT
C
  208 IF (CRITR(RSQ,T,JCRITR,LPEAK)-CRIT) 220,220,230
C
C-A BRANCH TO 220 IMPLIES NON-IMPROVEMENT.  EITHER RESORE OLD VALUE AND
C-GO TO NEXT PEAK (221 OR 223), OR TRY MOVING UP (222).
C
  220 IF (MM+1) 221,222,223
C
C-A BRANCH TO 221 IMPLIES THAT WE HAVE BEEN MOVING DOWN FOR 2 OR MORE
C-STEPS.  THIS IS THE FIRST NON-IMPROVEMENT.  RESTORE JUST FORMER VALUE
C-AND GO TO NEXT PEAK.
C
  221 ISAVE(LPEAK)=ISAVE(LPEAK)+1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C-A BRANCH TO 222 IMPLIES FIRST MOVE DOWN AND NON-IMPROVEMENT.  TRY
C-MOVING SAME PEAK UP
C
  222 MM=1
      ISAVE(LPEAK)=ISAVE(LPEAK)+2
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
  225 WRITE (KPRINT,3)
    3 FORMAT ('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK IN
     1TO THE LONGEST PERIOD (LOWEST FREQUENCY) BAND.  TRY WIDER SPECTRUM
     2 LIMITS.')
      GO TO 2000
C
```

```
C-A BRANCH TO 223 IMPLIES THAT WE HAVE BEEN MOVING UP AND IT DIDNT HELP.
C-RESTORE JUST PRIOR VALUE AND GO TO NEXT PEAK.
C
  223 ISAVE(LPEAK)=ISAVE(LPEAK)-1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C
C-A BRANCH TO 230 IMPLIES IMPROVEMENT.  CONTINUE IN SAME DIRECTION.
C
  230 IF (MM) 231,231,232
C
C-A BRANCH TO 231 IMPLIES WE WERE MOVING DOWN. - CONTINUE SAME DIRECTION
C
  231 MM=MM-1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK) =ISAVE(LPEAK)-1
      IF (ISAVE(LPEAK)-1) 234,234,300
  234 WRITE (KPRINT,4)
    4 FORMAT('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK INT
     1O THE SHORTEST PERIOD (HIGHEST FREQUENCY) BAND.  TRY WIDER SPECTRU
     2M LIMITS')
      GO TO 2000
C
C-A BRANCH TO 232 IMPLIES WE WERE MOVING UP. - CONTINUE SAME DIRECTION.
C
  232 MM=MM+1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK)=ISAVE(LPEAK)+1
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
C
C
C-STATEMENT 300 CHECKS TO SEE THAT WE ARE NOT OFF THE END OF THE ISAVE
C-VECTOR.  IF NOT, DO ANOTHER K-BANDS    SPECTRUM WITH NEW ISAVE VECTOR
C-VALUES.  IF WE ARE OFF THE END, COMPUTE A NEW FULL SPECTRUM USING A
C-K-VARIATE MODEL.  ALSO CHECK FOR VALUES OF ISAVE EQUAL TO EACH OTHER.
C-IF WE HAVE JUST MOVED INTO A ANOTHER PEAK, REDUCE NPEAK BY ONE AND
C-PACK THE VECTOR DOWN AND START PROCESS OVER AT LPEAK=1.
C
  300 IF (LPEAK-NPEAK) 320,320,310
  320 IF (LPEAK-1) 322,322,321
  321 IF (ISAVE(LPEAK)-ISAVE(LPEAK-1)) 322,323,322
  322 IF (LPEAK-NPEAK) 324,210,324
  324 IF (ISAVE(LPEAK)-ISAVE(LPEAK+1)) 210,325,210
  323 DO 330 LL=LPEAK,NPEAK
  330 ISAVE(LL-1)=ISAVE(LL)
      NPEAK=NPEAK-1
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
  325 NPEAK=NPEAK-1
      DO 331 LL=LPEAK,NPEAK
  331 ISAVE(LL)=ISAVE(LL+1)
```

```
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A BRANCH TO 310 OCCURS WHEN OPTIMIZATION OF THE K-BANDS MODEL IS
C-COMPLETE.  NOW COMPUTE A FULL SPECTRUM USING THE OPTIMIZED K-BANDS
C-MODEL.  SEARCH NEW K-B SPECTRUM FOR PEAKS AND SEE IF ANY NEW ONES TUR-
C-NED UP.  IF SO, GO THRU WHOLE OPTIMIZATION ROUTINE AGAIN.
C
  310 IF (JPRINT-3)360,361,361
  361 WRITE (KPRINT,9)
    9 FORMAT('1COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL')
      IF (JDOMAN)362,362,363
  362 DO 364 LO=1,NPEAK
      KK=ISAVE(LO)
  364 WRITE (KPRINT,8) BANDS(KK)
      GO TO 360
  363 DO 366 LO=1,NPEAK
      KK=ISAVE(LO)
  366 WRITE (KPRINT,8) BAN(KK)
  360 CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      KOUNT=KOUNT+1
      IF (KOUNT-KTOP) 384,384,385
  385 WRITE (KPRINT,386)
  386 FORMAT('1THE PROGRAM IS PROBABLY CAUGHT IN A LOOP.  TRY DIFFERENT
     1INPUT PARAMETERS AND SUBMIT AGAIN')
      GO TO 2000
  384 CALL PPIKR(B,T,ISAVE,NPEEK,NBANDS,SIGLEV)
      IF (NPEAK-NPEEK) 311,350,311
  311 NPEAK=NPEEK
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A STABLE STATE IN THE OPTIMIZING ROUTINE RESUTS IN A BRANCH TO 350.
C-OUTPUT RESULTS.-
C
  350 WRITE (KPRINT,67)
   67 FORMAT('0 M U L T I P L E    B A N D    S P E C T R U M')
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      WRITE (KPRINT,6) RSQ
C
C-CHECK FINAL SPECTRUM FOR EXCESSIVE TOTAL POWER IN SIGNIFICANT BANDS.
C
      CALL TOTAM(X,NOBS,NPEAK,ISAVE,M,PHASE,B,SUMB)
      IF(SUMB-TOPP) 381,382,382
  382 WRITE (KPRINT,383)
  383 FORMAT('1PROGRAM FAILED BY FINDING TOO MUCH POWER IN THE SPECTRUM.
     1',/,'  SUGGEST ALTERING PARAMETERS OF THE ANALYSIS, SUCH AS',/,
     2'   USE WIDER SPECTRUM LIMITS, FILTER DATA, ALTER DELTAP, ETC.')
  381 GO TO 2000
C
```

```
C
C*****************************************************************
C*****************************************************************
C
C
C-STATEMENTS 400-600 INVOLVE COMPUTATION OF THE SIMPLE, SINGLE BAND
C-SPECTRUM ONLY.
C
  400 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS,
     1 AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      GO TO 2000
C
C
C*****************************************************************
C*****************************************************************
C
C
C-STATEMENTS 600-800 INVOLVE COMPUTATION OF A SPECIFIC K-BAND MODEL
C-WITHOUT OPTIMIZATION.
C
C-FIRST READ IN MODEL PARAMETERS, BUILD VECTOR OF BANDS IN MODEL, THEN
C-COMPUTE SPECTRUM.
C
  600 READ (KREADR,1) NPEAK
      READ (KREADR,2) (PEAKS(LPEAK),LPEAK=1,NPEAK)
      DO 610 LPEAK=1,NPEAK
      DO 620 LBAND=1,NBAND
      IF (PEAKS(LPEAK)-BANDS(LBAND)) 620,630,620
  630 ISAVE(LPEAK)=LBAND
      GO TO 610
  620 CONTINUE
  610 CONTINUE
      CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      WRITE (KPRINT,5)
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,ANAME,TNAME,PHNAME,
     1 BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      WRITE (KPRINT,6) RSQ
 2000 STOP
      END
```

```
C
C
      SUBROUTINE REV(X,N)
      DIMENSION X(50)
C
C ********************************************************************
C *                                                                  *
C *     SUBROUTINE R E V                                             *
C *                                                                  *
C *   REV TAKES A VECTOR AND REVERSES ITS ORDER.                     *
C *                                                                  *
C ********************************************************************
C
      J=N+1
      MID=N/2
      DO 10 L=1,MID
      J=J-1
      SAVE=X(L)
      X(L)=X(J)
   10 X(J)=SAVE
      RETURN
      END
```

```
C
C
      SUBROUTINE PREGEN(X,BANDS,NOBS,NBANDS)
      DIMENSION X(1),BANDS(1)
C
C ***********************************************************************
C *                                                                     *
C *   SUBROUTINE P R E G E N
C *                                                                     *
C *  PREGEN GENERATES THE SINE AND COSINE PREDICTOR WAVES AND STORES   *
C *  THEM IN MATRIX X.  MATRIX X IS THE DATA MATRIX HAVING NOBS ROWS   *
C *  AND M COLUMNS.  HERE NOBS= THE NUMBER OF OBSERVATIONS AND         *
C *  BANDS IS A VECTOR OF PERIOD VALUES IN THE SPECTRUM.               *
C *                                                                     *
C *  MATRIX X IS STORED IN VECTOR MODE.   SEE IBM SYSTEM/360 SUB-      *
C *  ROUTINE PACKAGE (360A-CM-03X) VERSION III, PROGRAMMER'S MANUAL,   *
C *  PUBLICATION NUMBER H20-0205-3, PAGES 3-6.  ESSENTIALLY EACH COL-  *
C *  UMN OF MATRIX X IS STRUNG END-TO-END INTO ONE LONG VECTOR.        *
C *                                                                     *
C *  THE FIRST NOBS VALUES OF VECTOR (MATRIX) X WILL BE THE DEPENDENT *
C *  VARIABLE (SEE SUBROUTINE DEPVAR).  THE NEXT NOBS POINTS (COLUMN  *
C *  TWO) WILL CONTAIN COS WAVE, BAND 1, THE NEXT NOBS POINTS (COLUMN *
C *  THREE CONTAINS SIN WAVE, BAND 1, ETC.                             *
C *                                                                     *
C ***********************************************************************
C
C-CONVERT TO RADIANS/OBSERVATION AND LOOP THRU NBANDS TIMES.
C
      L=NOBS
      DO 10 LBAND=1,NBANDS
      AFREQ=6.28318/BANDS(LBAND)
      EF=-AFREQ
      DO 20 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   20 X(L)=COS(EF)
      EF=-AFREQ
      DO 10 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   10 X(L)=SIN(EF)
C
C-X CONTAINS THE VECTORS OF SIN/COS WAVES STRUNG END-TO-END.  THIS IS
C-EQUIVALENT TO A MATRIX WHERE EACH SIN OR COS WAVE FORMS A COLUMN OF
C-NOBS LENGTH.
C
      RETURN
      END
```

```
C
C
      SUBROUTINE DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
      DIMENSION X(1)
      COMMON KREADR
C
C **********************************************************************
C *                                                                    *
C *   SUBROUTINE D E P V A R
C *                                                                    *
C *  DEPVAR EITHER READS IN OR GENERATES (VIA SIMULA), A DEPENDENT     *
C *  VARIABLE VECTOR OF LENGTH NOBS.  THE DEPENDENT VARIABLE IS STORED*
C *  INTO THE FIRST NOBS CELLS OF X, A MATRIX OF VARIABLES STORED AS A*
C *  VECTOR OF COLUMNS.  SEE SUBROUTINE PREGEN FOR REST OF X.          *
C *                                                                    *
C **********************************************************************
C
C-IF JDATA IS 0 - READ FROM CARDS, (10X,7F10.0)
C-IF JDATA IS 1 - CALL SIMULA WHICH GENERATES DATA USING A MONTE CARLO
C-SYSTEM ALONG WITH DETERMINISTIC DATA.  SIMULA READS CARDS.
C
      IF (JDATA) 10,10,50
   10 READ (KREADR,1) (X(L),L=1,NOBS)
    1 FORMAT (10X,7F10.0)
      GO TO 20
   50 CALL SIMULA(X,NOBS,JDATA,JDOMAN,JPRINT)
   20 RETURN
      END
```

```
C
C
      SUBROUTINE SIMULA(X,N,J,JOOMAN,JPRINT)
      DIMENSION X(1),A(130),BAND(1)
      COMMON KREADR,KPRINT
C
C **********************************************************************
C *                                                                    *
C *   SUBROUTINE S I M U L A                                           *
C *                                                                    *
C *  SIMULA IS A PRIMATIVE MONTE CARLO AND SIGNAL GENERATOR FOR CREAT-*
C *  ING ARTIFICIAL DATA.  GAUSSIAN DATA ARE READ IN FROM CARDS AND    *
C *  A NUMBER OF SINE WAVES OF VARIABLE FREQUENCY AND AMPLITUDE ARE    *
C *  ADDED.                                                            *
C *                                                                    *
C **********************************************************************
C
C-ZERO VECTOR X AND PRINT HEADING
C
      DO 100 L=1,N
  100 X(L)=0.0
      IF (JPRINT) 110,110,120
  120 WRITE (KPRINT,121)
  121 FORMAT('1M O N T E    C A R L O    SIMULATED DATA',/,'0')
C
C-READ IN MODEL SPECIFICATIONS - GENERATE SINES AND ADD NOISE
C  NSIN-NUMBER OF SINE WAVES IN DATA
C  BAMD-FREQ. OR PERIOD OF THE LSINTH SINE WAVE
C  SD-STANDARD DEFIATION OF THE LSINTH SINE WAVE.  (AMPLITUDE)
C  SDN-STANDARD DEV. OF GAUSSIAN NOISE
C
  110 READ (KREADR,1) NSIN
    1 FORMAT (I5)
      DO 10 LSIN=1,NSIN
      READ (KREADR,2) BAND(1),SD
    2 FORMAT (2F10.0)
      IF (JOOMAN)20,20,30
   30 BAN=BAND(1)
      BAND(1)=1.0/BAND(1)
      GO TO 21
   20 BAN=1.0/BAND(1)
   21 IF (JPRINT) 25,25,22
   22 WRITE (KPRINT,3) LSIN, BAND(1), BAN,SD
    3 FORMAT(' BAND',I3,' - PERIOD=',F10.4,', FREQUENCY=',F10.4,', AMPLI
     1TUDE=',F10.4)
   25 AFREQ=6.28318/BAND(1)
      EF=-AFREQ
      DO 26 L=1,N
      EF=EF+AFREQ
   26 A(L)=SIN(EF)*1.41421
      DO 10 L=1,N
   10 X(L)=X(L)+A(L)*SD
C
C-READ IN NOISE SD AND NOISE CARDS
```

```
C
      READ (KREADR,2) SDN
      IF(SDN) 1000,1000,40
   40 IF (JPRINT) 50,50,41
   41 WRITE (KPRINT,5) SDN
    5 FORMAT('0RANDOM GAUSSIAN NOISE AMPLITUDE=',F10.4)
   50 READ (KREADR,6) (A(L),L=1,N)
    6 FORMAT(4X,10F6.4)
      DO 60 L=1,N
   60 X(L)=A(L)*SDN+X(L)
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE MATPRT(R,M,LVAR)
      DIMENSION R(1),X(15),LVAR(1)
      COMMON KREADR, KPRINT
C
C *****************************************************************
C *                                                               *
C *    SUBROUTINE M A T P R T                                     *
C *                                                               *
C *   MATPRT PRINTS OUT THE LOWER TRIANGULAR MATRIX X WHERE X IS STOR- *
C *   ED IN MODE 1.  SEE REFERENCE LISTED IN SUBROUTINE PREGEN.   *
C *                                                               *
C *****************************************************************
C
C-LOOP THRU AS MANY TIMES AS NEEDED TO PRINT WHOLE MATRIX, EACH TIME
C-PRINTING 15 COLUMNS BY NRO ROWS.
C
      N1=1
      N2=15
  110 IF (N2-M) 100,100,10
   10 N2=M
  100 WRITE (KPRINT,1)  (LVAR(LV),LV=N1,N2)
    1 FORMAT('0',2X,15I7)
      WRITE (KPRINT,2)
    2 FORMAT('0')
C
C-PRINT ONE ROW AT A TIME.  MATRIX R IS MODE 1, UPPER TRIANGULAR.
C-THEREFORE REVERSE SUBSCRIPTS TO MAKE LOWER TRIANGULAR.
C
      DO 20 LROW=N1,M
      IF (LROW-N2) 21,21,22
   21 LIMIT=LROW
      GO TO 23
   22 LIMIT=N2
   23 L=0
      DO 30 LCOL=N1,LIMIT
      L=L+1
      CALL LOC(LCOL,LROW,K,M,M,1)
   30 X(L)=R(K)
   20 WRITE (KPRINT,3) (LROW,(X(K),K=1,L))
    3 FORMAT(1X,I3,2X,15F7.3)
      N1=N1+15
      N2=N1+14
      IF (M-N1) 1000,110,110
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE USPECT(R,T,N    ,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,
     1 BANDS,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      DIMENSION R(1),T(1),B(1),STD(1),PHASE(1),BAN(1),BANDS(1),AMNAME(1)
     1,TNAME(1),PHNAME(1),XNAME(1),BANAME(1)
      COMMON KREADR,KPRINT
C
C ********************************************************************
C *                                                                  *
C     SUBROUTINE U S P E C T
C *                                                                  *
C *  USPECT COMPUTES THE UNIVARIATE SPECTRUM BY MULTIPLYING THE CORR- *
C *  ELATION OF THE TIME SERIES WITH A SIN OR COS PREDICTOR BY THE    *
C *  RATIO OF STANDARD DEVIATIONS OF THE TWO.  THIS IS DONE FOR EACH  *
C *  PREDICTOR.  LET R=THE CORRELATION OF F(T) WITH A SIN OR COS WAVE *
C *  OF SOME ARBITRARY WAVE LENGTH.  LET   S =THE STANDARD DEVIATION  *
C *  OF THE TIME SERIES AND .707=THE STANDARD DEVIATION OF THE PRED-  *
C *  ICTOR WAVE.  THEN  A(F) = R*(S/.707)                             *
C *  WHERE A(F)=THE AMPLITUDE OF THE COMPLEX SPECTRUM AT F.  THE SIN  *
C *  AND COS COMPONENTS ARE COMBINED AT EACH WAVE LENGTH AND PHASE    *
C *  ANGLE IS COMPUTED.  T-VALUES ARE ALSO COMPUTED FOR EACH BAND.    *
C *  R=UPPER TRIANGULAR CORRELATION MATRIX, IN STORAGE MODE 1.  SEE   *
C *  IBM PUBLICATION REFERENCED IN SUBROUTINE PREGEN.  (INPUT)        *
C *  T=VECTOR OF T-VALUES.  (OUTPUT)                                  *
C *  NOBS=NUMBER OF OBSERVATIONS.  (INPUT)                            *
C *  M=TOTAL NUMBER OF DATA VECTORS.  M=NBANDS*2 + 1.  ONE VECTOR FOR *
C *  THE DEPENDENT VARIABLE AND TWO FOR THE SIN/COS WAVES AT EACH WAVE*
C *  LENGTH.  (INPUT).  B=VECTOR OF SPECTRUM ESTIMATES.  (OUTPUT)     *
C *  NBANDS=LENGTH OF VECTORS T,B AND PHASE.  (INPUT)                 *
C *  STD=STANDARD DEVIATIONS OF ALL VARIABLES.  (INPUT)               *
C *  JPRINT=PRINT CONTROL - SEE MAINLINE.  (INPUT)                    *
C *  JPLOT=PLOT CONTROL - SEE MAINLINE.  (INPUT)                      *
C *  PHASE=VECTOR OF PHASE ANGLES.  (OUTPUT)                          *
C *                                                                  *
C ********************************************************************
      LBAND=0
C
C-EXTRACT VECTOR OF CORRELATIONS BETWEEN DEPENDENT VARIABLE AND EACH
C-PREDICTOR VARIABLE.
C
      DO 10 L=2,M
      CALL LOC(1,L,KOOL,M,M,1)
   10 B(L)=R(KOOL)
C
C-LOOP THRU THE SPECTRUM COMPUTATION NBAND TIMES.
C
      FACT=SQRT(FLOAT(N-2))
      DO 20 L=2,M,2
      K=L+1
      LBAND=LBAND+1
C
C-CO=COS COMPONENT OF SPECTRUM ESTIMATE
C-SI=SIN COMPONENT OF SPECTRUM ESTIMATE
```

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```
C-TC=T-VALUE FOR COS COMPONENT                                          USPT 550
C-TS=T-VALUE FOR SIN COMPONENT                                          USPT 560
C                                                                       USPT 570
      CO=B(L)*STD(1)/.707                                               USPT 580
      SI=B(K)*STD(1)/.707                                               USPT 590
      TC=B(L)*FACT/SQRT(1.0-B(L)**2)                                    USPT 600
      TS=B(K)*FACT/SQRT(1.0-B(K)**2)                                    USPT 610
C                                                                       USPT 620
C-COMPUTE SPECTRUM AMPLITUDE, T-VALUE AND PHASE ANGLE                   USPT 630
C                                                                       USPT 640
      B(LBAND)=SQRT(CO**2 + SI**2)                                      USPT 650
      T(LBAND)=SQRT(TC**2 + TS**2)                                      USPT 660
   20 PHASE(LBAND)=ATAN(CO/SI)                                          USPT 670
C                                                                       USPT 680
C-PRINT AND/OR PLOT IF DESIRED                                          USPT 690
C                                                                       USPT 700
      JPR=JPRINT-1                                                      USPT 740
      JPL=JPLOT-1                                                       USPT 750
      IF (JPR) 50,50,60                                                 USPT 760
   50 IF (JPL) 1000,1000,60                                             USPT 770
   60 WRITE(KPRINT,1)                                                   USPT 780
    1 FORMAT('0 S I N G L E   B A N D   S P E C T R U M')               USPT 790
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME        USPT 800
     1,BANAME,XNAME,JPRINT,JPLOT,JDOMAN)                                USPT 810
 1000 RETURN                                                            USPT 820
      END                                                               USPT 830
```

```
C
C
      SUBROUTINE PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      DIMENSION B(1),T(1),ISAVE(1)
C
C *********************************************************************
C *                                                                   *
C *   SUBROUTINE P P I K R                                            *
C *                                                                   *
C *  PPIKR RETURNS THE VECTOR INDEX OF ALL SIGNIFICANT SPECTRUM PEAKS.*
C *  B-INPUT VECTOR OF AMPLITUDE SPECTRUM ESTIMATES                   *
C *  T-INPUT VECTOR OF T-VALUES FOR EACH SPECTRUM ESTIMATE            *
C *  ISAVE-OUTPUT VECTOR OF INDEX NUMBERS OF SIGNIFICANT PEAKS        *
C *  NPEAK-OUTPUT SCALAR - NUMBER OF PEAKS FOUND                      *
C *  NBANDS-INPUT SCALAR - NUMBER OF BANDS IN SPECTRUM                *
C *  SIGLEV-INPUT SCALAR - CRITERION WHICH T-VALUE FOR A PEAK MUST    *
C *          EXCEED IN ORDER TO BE RETAINED                           *
C *                                                                   *
C *********************************************************************
C
C-SEARCH FOR PEAKS, RETAIN 'SIGNIFICANT' ONES, BUILD ISAVE.
C
      NPEAK=0
      DO 10 L=2,NBANDS
      IF (B(L-1)-B(L)) 20,10,10
   20 IF (B(L+1)-B(L)) 40,10,10
   40 IF (T(L)-SIGLEV) 10,50,50
   50 NPEAK=NPEAK+1
      ISAVE(NPEAK)=L
   10 CONTINUE
      RETURN
      END
```

```
C
C
      FUNCTION CRITR(RSQ,T,JCRITR,L)
      DIMENSION T(1)
C
C *********************************************************************
C *                                                                   *
C *   FUNCTION C R I T R                                              *
C *                                                                   *
C *  CRITR SELECTS A CRITERION FOR THE SPECTRUM OPTIMIZATION BY PEAK  *
C *  SHIFTING.  SELECTS EITHER R-SQUARE OR THE APPROPRIATE T VALUE.   *
C *                                                                   *
C *********************************************************************
C
C-SELECT APPROPRIATE VALUE FOR CRITERION.
C  RSQ-INPUT SCALAR - VALUE OF R-SQUARE
C  T-INPUT VECTOR - T-VALUES
C  JCRITR-CONTROL DIGIT FOR SELECTION OF EITHER RSQ OR T(L) AS CRITERION
C         0=RSQ AS CRITERION
C         1=T-VALUE AS CRITERION
C  L-INDEX VALUE OF VECTOR T
C
      IF (JCRITR) 10,10,20
   10 CRITR=RSQ
      GO TO 30
   20 CRITR=T(L)
   30 RETURN
      END
```

```
C
C
      SUBROUTINE KSPECT(R,T,N,M,NPEAK,ISAV ,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE, BANDS,BAN)
      DIMENSION ISAVE(100)    ,R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),
     1PHASE(1),BANDS(1),BAN(1)                        ,ANS(10),ISAV(1),RY(100)
      COMMON KREADR,KPRINT
C-CONVERT ISAV TO ISAVE, FROM FREQ BAND VECTOR TO VECTOR OF SIN/COS PAIR
C
98521 FORMAT ('0JKL=',I5)
      K=0
      DO 100 L=1,NPEAK
      K=K+1
      ISAVE(K)=ISAV(L)*2
      K=K+1
  100 ISAVE(K)=ISAVE(K-1)+1
C
C-SELECT SUB-MATRIX OF PREDICTORS ETC FROM R, ACCORDING TO ISAVE.
C
      CALL ORDER(M,R,1,K     ,ISAVE,RX,RY)
C
C-INVERT K-ORDER MATRIX OF PREDICTOR INTERCORRELATIONS, RX
C
      CALL MINV(RX,K,DET,B,T)
      IF (JPRINT-3) 300,400,400
  400 WRITE (KPRINT,7) DET
    7 FORMAT('0',/,'0 DETERMINANT =',E30.15)
C
C-COMPUTE REGRESSIONS(SPECTRUM) FOR NPEAK SIZED MODEL.
C
  300 CALL MULTR(N,K,XBAR,STD,D,RX,RY,ISAVE,B,SB,T,ANS)
      RSQ=ANS(2)**2
C
C-CONVERT SPECTRUM TO AMPLITUDES BY COMBINING SIN/COS.  PUT INTO D.
C-ALSO CONVERT T.
C
      NFREQ=0
      DO 200 L=1,K,2
      NFREQ=NFREQ+1
      PHASE(NFREQ)=ATAN(B(L)/B(L+1))
      B(NFREQ)=SQRT(B(L)**2 + B(L+1)**2)
  200 T(NFREQ)=SQRT(T(L)**2 + T(L+1)**2)
   10 RETURN
      END
```

```
C
C
      SUBROUTINE MULTI(ISAVE,NPEAK,NBANDS,R,T,N,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      DIMENSION ISAVE(1),R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),PHASE
     1 (1),BANDS(1),BAN(1),KSAVE(20),S(20),TSPEC(20),TPH(20)
      COMMON KREADR,KPRINT
C
C ***********************************************************************
C *                                                                     *
C *   SUBROUTINE M U L T I                                              *
C *                                                                     *
C *  MULTI COMPUTES THE FULL SPECTRUM OF A TIME SERIES USING A K+1      *
C *  BANDS    MODEL WHERE K=THE NUMBER OF PEAKS IN THE CPTOMIZED        *
C *  MODEL.  THE EXTRA BAND IS THE WAVELENGTH IN QUESTION, THE OTHERS   *
C *  ARE THE SIGNIFICANT PEAKS.  THE VARIANCE ACCOUNTED FOR BY          *
C *  THE SIGNIFICANT PEAKS IS THUS 'ACCOUNTED FOR' IN EACH ESTIMATE.    *
C *  WHEN THE CURRENT BAND IS ONE OF THE SIGNIFICANT PEAKS, A SKIP      *
C *  OCCURS.  VARIABLES DEFINED IN MAINLINE.                            *
C *                                                                     *
C ***********************************************************************
C
C
C-LOOP THRU ONCE FOR EACH FREQ BAND.  NFMOD IS THE NUMBER OF SIGNICIC-
C-CANT PEAKS IN MODEL PLUS A CURRENT BAND.
C
      NFMOD=NPEAK+1
      DO 310 LF=1,NBANDS
C
C-CONSTRUCT NEW ISAVE VECTOR
C
      CALL BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
C
C-SKIP IF THIS BAND IS IN THE MODEL ALREADY
C
      IF (ISKIP) 320,320,330
C
C-BRANCH TO 330 IMPLIES THAT THE CURRENT BAND IS ONE OF THE SIGNIFICANT
C-PEAKS.  DO AN NPEAK SPECTRUM AND PICK OUT CURRENT BAND.
C
  330 CALL<SPECT(R,S,N,M,NPEAK,ISAVE,RX,TSPEC,O,XBAR,STD,D,RSQ,TPH,
     1BANDS,BAN)
C
C-TSPEC CONTAINS ALL MODEL ESTIMATES.  PICK THE ONE FOR LF.
C
      DO 331 LLZ=1,NPEAK
      IF (LF-ISAVE(LLZ)) 331,333,331
  333 B(LF)=TSPEC(LLZ)
      PHASE (LF)=TPH(LLZ)
      T(LF)=S(LLZ)
  331 CONTINUE
      GO TO 310
C
C-BRANCH TO 320 IMPLIES THAT THIS IS A FULL NFMOD MODEL.  DO SPECTRUM
```

```
C-AND PICK OUT CURRENT BAND.
C
  320 CALLKSPECT(R,S,N,M,NFMOD,KSAVE,RX,TSPEC,O,XBAR,STD,D,RSQ,TPH,
     1 BANDS,BAN)
      DO 321 LLL=1,NFMOD
      IF(LF-KSAVE(LLL)) 321,322,321
  322 T(LF)=S(LLL)
      B(LF)=TSPEC(LLL)
      PHASE (LF)=TPH(LLL)
  321 CONTINUE
  310 CONTINUE
      RETURN
      END
```

```
C
C
      SUBROUTINE BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
      DIMENSION KSAVE(1),ISAVE(1),ASAVE(30),RANC(30)
C
C *********************************************************************
C *                                                                   *
C     SUBROUTINE B U I L D
C *   BUILD CONSTRUCTS VECTOR OF RANKED FREQ BAND NUMBERS GIVEN A     *
C *   PARTICULAR MODEL AND A CURRENT FREQUENCY.                       *
C *   KSAVE - OUTPUT VECTOR TO BE BUILT                               *
C *   ISAVE - INPUT VECTOR CONTAINING NFREQ SIGNIF PEAKS              *
C *   LF - INPUT SCALAR - NEW FREQ BAND TO BE ADDED (CURRENT ONE)     *
C *   NFMOD - INPUT - NUMBER OF FREQ BANDS IN NEW MODEL               *
C *   ISKIP - OUTPUT CONTROL DIGIT TO KEEP FROM COMPUTING ESTIMATE    *
C *            OF ONE OF THE OLD PEAKS AGAIN                          *
C *   NPEAK - INPUT - NUMBER OF FREQ BANDS IN OLD MODEL               *
C *                                                                   *
C *********************************************************************
C
C-SEE IF LF IS ALREADY IN MODEL
C
      DO 10 L=1,NPEAK
      IF(LF - ISAVE(L)) 10,99,10
   10 CONTINUE
C
C-STORE VECTOR OF ISAVE PLUS LF INTO ASAVE AND RANK IT.  RANK STORED IN
C-VECTOR RANC
C
      DO 20 L=1,NPEAK
   20 ASAVE(L)=ISAVE(L)
      ASAVE(NFMOD)=LF
      CALL RANK(ASAVE,RANC,NFMOD)
C
C-BUILD KSAVE OF RANKED FREQ BANDS
C
      DO 30 L=1,NFMOD
      KOOL=RANC(L)
   30 KSAVE(KOOL)=ASAVE(L)
      ISKIP=0
      GO TO 100
   99 ISKIP=1
  100 RETURN
      END
```

```
C
C
      SUBROUTINE OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      DIMENSION BANDS(1),BAN(1),B(1),T(1),PHASE(1),AMNAME(1),TNAME(1),
     1PHNAME(1),BANAME(1),XNAME(1)
      COMMON KREADR,KPRINT
C
C ********************************************************************
C *                                                                  *
C *   SUBROUTINE O U T P U T                                         *
C *                                                                  *
C *  OUTPUT PRINTS AND/OR PLOTS SPECTRA WITH DOCUMENTATION.          *
C *                                                                  *
C ********************************************************************
C
C-PRINT OUT DOCUMENTATION AND VECTOR ORDER IN APPROPRIATE DOMAIN)
C-FIND SCALE VALUES AND PLOT
C
      TOPI=6.28318
      BTOPI=-TOPI
      BMAX=B(1)
      DO 64 LBAND=2,NBANDS
      IF (BMAX-B(LBAND)) 68,64,64
   68 BMAX=B(LBAND)
   64 CONTINUE
      TMAX=T(1)
      DO 66 LBAND=2,NBANDS
      IF (TMAX-T(LBAND)) 67,66,66
   67 TMAX=T(LBAND)
   66 CONTINUE
      IF (JDOMAN) 60,60,50
C
C-REVERSE VECTORS IF FREQ DOMAIN IS USED - PRINT - REVERSE AGAIN.
C
   50 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      IF (JPRINT) 52,52,51
   51 WRITE (KPRINT,2)
    2 FORMAT('OFREQUENCY ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 55 LBAND=1,NBANDS
   55 WRITE (KPRINT,3) BAN(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
    3 FORMAT(F10.3,5X,F9.3,5X,F7.3,5X,F8.3)
   52 IF (JPLOT) 54,54,53
   53 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BAN,AMNAME,TNAME,BANAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BAN,PHNAME,TNAME,
     1 BANAME)
   54 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      GO TO 100
   60 IF (JPRINT) 62,62,61
   61 WRITE (KPRINT,4)
```

```
    4 FORMAT('OPERIOD     ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 65 LBAND=1,NBANDS
   65 WRITE (KPRINT,3) BANDS(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
   62 IF (JPLOT) 100,100,63
   63 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BANDS,AMNAME,TNAME,XNAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BANDS,PHNAME,TNAME,
     1 XNAME)
  100 RETURN
      END
```

```
C
C
      SUBROUTINE PLOT2(Y1,YMAX1,YMIN1,Y2,YMAX2,YMIN2,NP,XAX,YNAM1,
     1 YNAM2,XNAM)
      DIMENSION Y1(1),Y2(1),LINE(111),XAX(1),XNAM(5),YNAM1(9),YNAM2(9)
      COMMON KREADR,KPRNT
      DATA KBLNK/' '/,KBORD/'.'/,KAL/'+'/,KPLOT/'*'/
C
C--PLOT2 GENERATES TWO OVER/UNDER     GRAPHS PER PAGE AND CALIBRATES
C--THEM. Y1=VERTICAL VARIABLE 1, YMAX1, YMIN1=VERTICAL PLOT LIMITS.
C--Y2, YMAX2, YMIN2=SIMILAR FOR SECON VARIABLE, NP=NUMBER OF POINTS,
C--XAX=X AXIS (COMMON TO BOTH VARIABLES).
      WRITE (KPRNT,2)       YNAM1,YNAM2,XNAM
    2 FORMAT('1'       / T5,'*'/ T5,'*',T25,'*',T80,'*'/ T5,'*',T25,'***'
     1,T80,'***'/ T3,'*****',T18,'************ ',9A4,T73,'************ '
     2,9A4/T4,'***',T25, '***', T80,'***'/T5,'*',T25,'*',T80,'*'/1X,5A4)
C
C--GENERATE SCALE FACTORS
      SKAL1=50.5/(YMAX1-YMIN1)
      SKAL2=50.5/(YMAX2-YMIN2)
C--GENERATE CALIBRATION AND OUTPUT IT.
      CAL01 = YMIN1
      CAL02 = YMIN2
      CAL1 = YMAX1
      CAL2 = YMAX2
      CAL51=YMAX1-(.5*(YMAX1-YMIN1))
      CAL52=YMAX2-(.5*(YMAX2-YMIN2))
      WRITE (KPRNT,1) CAL01,CAL51,CAL1,CAL02,CAL52,CAL2
    1 FORMAT (' ',F14.4,F24.4,F23.4,F12.4,F23.4,F24.4)
C--GENERATE VERTICAL AXIS AND OUTPUT IT
      DO 10 L = 1,111
   10 LINE(L) = KBORD
      LINE(1) = KAL
      LINE(26) = KAL
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
      DO 20 L=52,60
   20 LINE(L) = KBLNK
      WRITE(KPRNT,4) LINE
    4 FORMAT(10X,111A1)
C
C--DECIDE HOW MANY LINES BETWEEN POINTS
      NWIDE = 32/NP
C
C--LOOP FOR NUMBER OF POINTS, EACH TIME PLOTTING A POINT AND NWIDE SPACE
      DO 30 LP = 1, NP
C
C--CLEAR LINE AND GENERATE GRID POINTS
      DO 40 L = 1,111
   40 LINE(L) = KBLNK
      LINE (1)=KBORD
      LINE(26)=KBORD
```

```
      LINE(51)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--TEST FOR OVER OR UNDER RANGE AND TRUNCATE OUT-OF-BOUNDS VALUES
      IF (Y1(LP)-YMAX1) 2000, 2000, 2100
 2100 YA      = YMAX1
      GO TO 5100
 2000 IF(Y1(LP)-YMIN1)5000, 5200, 5200
 5000 YA      = YMIN1
      GO TO 5100
 5200 YA=Y1(LP)
 5100 IF (Y2(LP)-YMAX2) 200, 200, 210
  210 YB      = YMAX2
      GO TO 510
  200 IF (Y2(LP)-YMIN2) 500, 520, 520
  500 YB      = YMIN2
      GO TO 510
  520 YB=Y2(LP)
C
C--NOW GENERATE POINT INDEXES
  510 K1 = (YA    -YMIN1)*SKAL1+1.0
      K2 = (YB    -YMIN2)*SKAL2+61.0
      LINE(K1)= KPLOT
      LINE(K2)= KPLOT
C
C--OUTPUT HORIZONTAL SCALE VALUE AND LINE
      WRITE (KPRNT ,3) XAX(LP),LINE
    3 FORMAT (1X,F 8.4,1X,111A1)
C
C--CLEAR LINE AND GENERATE BLANK LINES FOR SPACE
      IF (NWIDE) 30,30,110
  110 DO 95 L=1,111
   95 LINE(L )=KBLNK
      LINE (1)=KBORD
      LINE(51)=KBORD
      LINE(26)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--OUTPUT PLAIN LINE
      DO 90 LOOP=1,NWIDE
   90 WRITE (KPRNT,4) LINE
   30 CONTINUE
C
C--GENERATE RIGHT BORDER AND OUTPUT
      DO 50 L = 1,111
   50 LINE(L) = KBORD
      LINE(1) = KAL
      LINE(26) = KAL
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
```

```
      DO 80 L= 52,60                                                    PLT21110
   80 LINE (L) = KBLNK                                                  PLT21120
      WRITE (KPRNT,4) LINE                                              PLT21130
      RETURN                                                            PLT21140
      END                                                               PLT21150
```

```
C
C
      SUBROUTINE TOTAM(X,N,NPEAK,ISAVE,M,PHASE,B,AMP)
      DIMENSION X(1),ISAVE(1),PHASE(1),B(1)
C
C *********************************************************************
C *                                                                   *
C *   SUBROUTINE T O T A M                                            *
C *                                                                   *
C *   TOTAM COMPUTES THE RESULTANT AMPLITUDE OF THE SUM OF NPEAK SIN- *
C *   SOIDS WHICH HAVE THEIR AMPLITUDES AND PHASES DETREMINED BY THE  *
C *   CALLING PROGRAM..  TOTAM SIMPLY SELECTS THE APPROPRIATE SINE    *
C *   AND COSINE WAVES FROM X, WEIGHTS THEM, SUMS THEM AND THEN COM-  *
C *   PUTES THE AMPLITUDE OF THE SUM.                                 *
C *   W A R N I N G    -------    THIS WILL DESTROY ROW 1 OF X WHICH  *
C *   CONTAINS THE ORIGINAL DEPENDENT VARIABLE.                       *
C *                                                                   *
C *********************************************************************
C
C-LOOP THRU THE FOLLOWING NPEAK TIMES TO CREATE THE RESULTANT WAVE INX
C
      DO 100 LP=1,NPEAK
      K=ISAVE(LP)
      KC=K*2
      KS=KC+1
C
C-THE FOLLOWING COMPUTES THE PROPER AMPLITUDES FOR THE COSINE AND SINE
C-COMPONENTS, BASED ON PHASE AND AMPLITUDE ESTIMATES.
C
      PC=1.0
      PC=PC/(TAN(PHASE(K))+ PC)
      PS=PC*TAN(PHASE(K))
C
C-SELECT SINE AND COSIND VALUES FROM X A
C-SELECT SINE AND COSINE VALUES FROM X, SUM AND PUT INTO X, ROW 1.
C
      DO 100 L=1,N
      CALL LOC(KC,L,J,M,N,0)
      CALL LOC(KS,L,I,M,N,0)
  100 X(L)=X(J)*PC + X(I)*PS
C
C-COMPUTE APLLITUDE OF RESULTANT
C
      SX=0.0
      DO 10 L=1,N
   10 SX=SX+X(L)
      SX=SX/FLOAT(N)
      SXS=0.0
      DO 20 L=1,N
   20 SXS=SXS+(X(L)-SX)**2
      AMP=SQRT(SXS/FLOAT(N))
      RETURN
      END
```

```
SUBROUTINE DATA
RETURN
END
```

NOTE: The following IBM Scientific Subroutines must be included in the program:

CORRE, LOC, ORDER, MINV, MULTR, RANK

```
C
C
C**********************************************************************
C**********************************************************************
C
C
      DIMENSION BANDS( 50),BAN( 50),PEAKS(50),PHASE(50),AMNAME(9),TNAME
     1(9),PHNAME(9),BANAME(5),XNAME(5),LVAR(100),ISAVE(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- NOBS*(NBANDS*2+1)
C
      DIMENSION X(30000)
C
C-THE FOLLOWING DIMENSIONS MUST BE EQUAL TO OR GREATER THAN NBANDS*2+1
C
      DIMENSION XBAR(100),STD(100),B(100),D(100),T(100)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN
C- M*M, WHERE M=2*NBANDS+1
C
      DIMENSION RX(10000)
C
C-THE FOLLOWING DIMENSION MUST BE EQUAL TO OR GREATER THAN (M+1)*M/2
C
      DIMENSION R(5050)
      COMMON KREADR,KPRINT
      DATA AMNAME/'AMPL','ITUD','E ES','IMAT','E.  ','    ','    ','    ',
     1'    '/
      DATA  TNAME/'T-VA','LUE.','    ','    ','    ','    ','    ','    ',
     1'    '/
      DATA PHNAME/'PHAS','E ES','TIMA','TE. ','    ','    ','    ','    ',
     1'    '/
      DATA BANAME/'FREQ','UENC','Y   ','    ','    '/
      DATA  XNAME/'PERI','OD  ','    ','    ','    '/
      KREADR=5
      KPRINT=6
C
C-READ IN CONTROL DIGITS AS FOLLOWS AND PRINT THEM OUT.
C  JDOMAN-DOMAIN OF ANALYSIS.  0 OR BLANK=PERIOD, 1=FREQUENCY.
C  JBANDS-HOW VECTOR OF FREQUENCY OR PERIOD BANDS WILL BE OBTAINED.
C         0 OR BLANK=GENERATE ACCORDING TO LIMITS SUBSEQUENTLY READ IN.
C         1=READ IN A VECTOR OF BANDS TO BE USED FROM CARDS.
C  NBANDS-HOW MANY FREQUENCY OR PERIOD BANDS WILL BE USED.
C  NOBS-THE NUMBER OF OBSERVATIONS IN THE DATA VECTOR
C  JANALY-HOW THE DATA SHALL BE ANALYZED.
C         0 OR BLANK=DO UNIVARIATE SPECTRUM, SEARCH FOR BEST K-VARIATE
C                    MODEL
C         1=SIMPLY DO UNIVARIATE SPECTRUM
C         2=DO K-VARIATE SPECTRUM ACCORDING TO MODEL PARAMETER READ IN
C  JDATA-TELLS SUBROUTINE DEPVAR WHERE TO GET DATA.
C        0 OR BLANK=READ FROM CARDS ACCORDING TO FORMAT (10X,7F10.0)
C         1=GENERATE DATA FROM MODELING PROGRAM CALLED BY DATA.  THIS
C          MODELING PROGRAM WILL ASK FOR MORE CARDS.
```

```
C  JCRITR-SELECTS CRITERION FOR OPTIMIZATION OF K-VARIATE SPECTRUM.
C          0 OR BLANK=MULTIPLE R-SQUARED
C          1=T-VALUES
C  JPRINT-PRINTOUT CONTROL DIGIT
C          0=DONT PRINT ANY RESULTS
C          1=PRINT ONLY FINAL RESULTS
C          2=PRINT FINAL AND INTERMEDIATE RESULTS
C          3=PRINT AS FOR 2 PLUS MATRICES, CORRELATIONS,ETC FOR EACH STEP
C  JPLOT-PLOT CONTROL DIGIT. - VALUES AS ABOVE EXCEPT FOR 3.
C
      READ (KREADR,1) JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
    1 FORMAT (16I5)
      WRITE (KPRINT,103)
  103 FORMAT ('1 * * * * * * *  PROGRAM PARAMETERS * * * * * * * * *')
      WRITE (KPRINT,1)JDOMAN,JBANDS,NBANDS,NOBS,JANALY,JDATA,JCRITR,
     1 JPRINT,JPLOT
C
C-KTOP =MAX NUMBER OF TIMES THE PROGRAM WILL BE ALLOWED TO TRY IMPROVE-
C-MENTS ON THE WHOLE MULTIVARIATE SPECTRUM.  KOUNT IS THE NUMBER OF
C-SUCH TRIES.
C
      KTOP=4
      KOUNT=0
C
C-SET SIGLEV, THE T-VALUE FOR THE CRITERION OF ACCEPTANCE OF A PEAK.
C-THEN DECIDE HOW TO GET VECTOR OF BANDS.
C
      SIGLEV=2.0
      IF (JBANDS) 100,100,110
C
C-READ IN LIMITS OF BANDS VECTOR IF JBANDS WAS 0 - GENERATE BANDS.
C-OTHERWISE GO TO 110 AND READ IN BANDS FROM CARDS.
C  BANDLO-LOWEST FREQ. OR LONGEST PERIOD, AS APPROPRIATE TO DOMAIN.
C  BANDEL-DELTA(FREQ.) OR DELTA(PERIOD), AS APPROPRIATE TO DOMAIN.
C  BANDS-VECTOR OF BANDS.
C
  100 READ (KREADR,2) BANDLO,BANDEL
    2 FORMAT (8F10.0)
      BANDS(1)=BANDLO
      DO 120 LBAND=2,NBANDS
  120 BANDS(LBAND)=BANDS(LBAND-1) + BANDEL
      GO TO 130
  110 READ (KREADR,2) (BANDS(LBAND),LBAND=1,NBANDS)
C
C-CONVERT BANDS TO PERIOD DOMAIN IF ORIGINATED IN FREQ DOMAIN.
C-REVERSE THE ORDER OF BANDS SO AS TO BE IN ASCENDING WAVELENGTH ORDER.
C-ALSO GENERATE BAN, THE FREQ DOMAIN VECTOR OF BANDS.
C
  130 IF (JDOMAN) 150,150,140
  140 DO 141 LBAND=1,NBANDS
      BAN(LBAND)=BANDS(LBAND)
  141 BANDS(LBAND)=1.0/BANDS(LBAND)
      CALL REV(BANDS,NBANDS)
C
C-GENERATE SIN/COS PREDICTOR MATRIX AS PART OF DATA MATRIX, X.  THEN
```

```
C-READ IN DEPENDENT VARIABLE PART OF X.  THESE DATA WILL THEN BE ENT-
C-ERED INTO SUBROUTINE CORRE TO COMPUTE THE CORRELATION MATRIX OF ALL
C-VARIABLES.
C
  150 M=NBANDS*2 + 1
      CALL PREGEN(X,BANDS,NOBS,NBANDS)
      CALL DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
C
C-GENERATE VECTOR OF VARIABLE NUMBERS FOR LATER USE.
C
      DO 155 LV=1,M
  155 LVAR(LV)=LV
      CALL CORRE(NOBS,M,1,X,XBAR,STD,RX,R,B,D,T)
C
C-SET TOPP, THE MAXIMUM ALLOWABLE TOTAL AMPLITUDE IN THE FINAL SPECTRUM
C-TOPP IS THE TOTAL AMPLITUDE OF THE F(T)+25 PERCENT.
C
      TOPP=STD(1)+.25*STD(1)
C
C-PRINT OUT MATRICES ETC., IF DESIRED
C
      IF(JPRINT-3) 151,152,152
  152 WRITE (KPRINT,5)
    5 FORMAT('1M A T R I X    O F    C O R R E L A T I O N S',/,' VARIAB
     1LE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAV
     2ES OF VARIOUS PERIODS ',/,T88,'-------',/,'0')
      CALL MATPRT(R,M,LVAR)
C
C-DECIDE ON PROPER DATA ANALYSIS PATH.
C
  151 JANALY=JANALY+1
      GO TO (200,400,600),JANALY
C
C
C*********************************************************************
C*********************************************************************
C
C
C-STATEMENTS 200-400 INVOLVE COMPUTATION OF OPTIMIZED K-BANDS SPECTRA
C
C-FIRST COMPUTE UNIVARIATE SPECTRUM USING SUBROUTINE USPECT.  THEN FIND
C-ALL SIGNIFICANT SPECTRUM PEAKS IN UNIVARIATE SPECTRUM.
C
  200 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS
     1,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      CALL  PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      IF (NPEAK) 201,201,202
  201 WRITE (KPRINT,66)
   66 FORMAT('0** * *  * NO SIGNIFICANT PEAKS FOUND *   * * **')
      GO TO 2000
C
C-NOW LOOP THRU AN OPTIMIZING PROCESS TRYING TO FIND LARGEST VALUE OF
C-EITHER T OR R-SQUARE.  THE BEGINNING OF THIS LOOP IS STATEMENT 210
C
C-SET A VALUE OF CRIT=0.  THIS WILL LATER BE USED TO STORE THE JUST
C-PRECEDING VALUE OF THE OPTIMIZATION CRITERION.  ALSO INITIALIZE THE
```

```
C-VARIABLE MM =-1.  MM IS THE DIRECTION OF PEAK SLIDING AS WELL AS THE
C-COUNTER FOR THE NUMBER OF STEPS.
C
  202 LPEAK=1
      CRIT=0.0
      MM=0
  210 CALL KSPECT(R,T,NOBS,M,NPEAK,ISAVE,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE,BANDS,BAN)
C
C-TEST FOR PRINTOUT
C
      IF(JPRINT-3)208,209,209
  209 WRITE (KPRINT,6) RSQ
    6 FORMAT ('OMULTIPLE SQUARED CORRELATION=',F8.4)
      WRITE (KPRINT,7)
    7 FORMAT(' PERIOD/FREQ.',T20,'AMPLITUDE',T40,'T-VALUE')
      DO 214 LO=1,NPEAK
      KK=ISAVE(LO)
      IF (JDOMAN) 212,212,213
  212 BB=BANDS(KK)
      GO TO 214
  213 BB=BAN(KK)
  214 WRITE (KPRINT,8) BB,B(KK),T(KK)
    8 FORMAT (2F12.4,F18.4)
C
C-SELECT CRITERION FOR GOODNESS OF FIT - CHECK FOR IMPROVEMENT
C
  208 IF (CRITR(RSQ,T,JCRITR,LPEAK)-CRIT) 220,220,230
C
C-A BRANCH TO 220 IMPLIES NON-IMPROVEMENT.  EITHER RESORE OLD VALUE AND
C-GO TO NEXT PEAK (221 OR 223), OR TRY MOVING UP (222).
C
  220 IF (MM+1) 221,222,223
C
C-A BRANCH TO 221 IMPLIES THAT WE HAVE BEEN MOVING DOWN FOR 2 OR MORE
C-STEPS.  THIS IS THE FIRST NON-IMPROVEMENT.  RESTORE JUST FORMER VALUE
C-AND GO TO NEXT PEAK.
C
  221 ISAVE(LPEAK)=ISAVE(LPEAK)+1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C-A BRANCH TO 222 IMPLIES FIRST MOVE DOWN AND NON-IMPROVEMENT.  TRY
C-MOVING SAME PEAK UP
C
  222 MM=1
      ISAVE(LPEAK)=ISAVE(LPEAK)+2
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
  225 WRITE (KPRINT,3)
    3 FORMAT ('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK IN
     1TO THE LONGEST PERIOD (LOWEST FREQUENCY) BAND.  TRY WIDER SPECTRUM
     2 LIMITS.')
      GO TO 2000
C
```

```
C-A BRANCH TO 223 IMPLIES THAT WE HAVE BEEN MOVING UP AND IT DIDNT HELP.
C-RESTORE JUST PRIOR VALUE AND GO TO NEXT PEAK.
C
  223 ISAVE(LPEAK)=ISAVE(LPEAK)-1
      MM=-1
      LPEAK=LPEAK+1
      ISAVE(LPEAK)=ISAVE(LPEAK)-1
      GO TO 300
C
C
C-A BRANCH TO 230 IMPLIES IMPROVEMENT.  CONTINUE IN SAME DIRECTION.
C
  230 IF (MM) 231,231,232
C
C-A BRANCH TO 231 IMPLIES WE WERE MOVING DOWN. - CONTINUE SAME DIRECTION
C
  231 MM=MM-1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK) =ISAVE(LPEAK)-1
      IF (ISAVE(LPEAK)-1) 234,234,300
  234 WRITE (KPRINT,4)
    4 FORMAT('0** * *  * W A R N I N G * - JUST TRIED TO MOVE A PEAK INT
     1O THE SHORTEST PERIOD (HIGHEST FREQUENCY) BAND.  TRY WIDER SPECTRU
     2M LIMITS')
      GO TO 2000
C
C-A BRANCH TO 232 IMPLIES WE WERE MOVING UP. - CONTINUE SAME DIRECTION.
C
  232 MM=MM+1
      CRIT=CRITR(RSQ,T,JCRITR,LPEAK)
      ISAVE(LPEAK)=ISAVE(LPEAK)+1
      IF (ISAVE(LPEAK)-NBANDS) 300,225,225
C
C
C-STATEMENT 300 CHECKS TO SEE THAT WE ARE NOT OFF THE END OF THE ISAVE
C-VECTOR.  IF NOT, DO ANOTHER K-BANDS    SPECTRUM WITH NEW ISAVE VECTOR
C-VALUES.  IF WE ARE OFF THE END, COMPUTE A NEW FULL SPECTRUM USING A
C-K-VARIATE MODEL.  ALSO CHECK FOR VALUES OF ISAVE EQUAL TO EACH OTHER.
C-IF WE HAVE JUST MOVED INTO A ANOTHER PEAK, REDUCE NPEAK BY ONE AND
C-PACK THE VECTOR DOWN AND START PROCESS OVER AT LPEAK=1.
C
  300 IF (LPEAK-NPEAK) 320,320,310
  320 IF (LPEAK-1) 322,322,321
  321 IF (ISAVE(LPEAK)-ISAVE(LPEAK-1)) 322,323,322
  322 IF (LPEAK-NPEAK) 324,210,324
  324 IF (ISAVE(LPEAK)-ISAVE(LPEAK+1)) 210,325,210
  323 DO 330 LL=LPEAK,NPEAK
  330 ISAVE(LL-1)=ISAVE(LL)
      NPEAK=NPEAK-1
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
  325 NPEAK=NPEAK-1
      DO 331 LL=LPEAK,NPEAK
  331 ISAVE(LL)=ISAVE(LL+1)
```

```
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A BRANCH TO 310 OCCURS WHEN OPTIMIZATION OF THE K-BANDS MODEL IS
C-COMPLETE.  NOW COMPUTE A FULL SPECTRUM USING THE OPTIMIZED K-BANDS
C-MODEL.  SEARCH NEW K-B SPECTRUM FOR PEAKS AND SEE IF ANY NEW ONES TUR-
C-NED UP.  IF SO, GO THRU WHOLE OPTIMIZATION ROUTINE AGAIN.
C
  310 IF (JPRINT-3)360,361,361
  361 WRITE (KPRINT,9)
    9 FORMAT('1COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL')
      IF (JDOMAN)362,362,363
  362 DO 364 LO=1,NPEAK
      KK=ISAVE(LO)
  364 WRITE (KPRINT,8) BANDS(KK)
      GO TO 360
  363 DO 366 LO=1,NPEAK
      KK=ISAVE(LO)
  366 WRITE (KPRINT,8) BAN(KK)
  360 CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      KOUNT=KOUNT+1
      IF (KOUNT-KTOP) 384,384,385
  385 WRITE (KPRINT,386)
  386 FORMAT('1THE PROGRAM IS PROBABLY CAUGHT IN A LOOP.  TRY DIFFERENT
     1INPUT PARAMETERS AND SUBMIT AGAIN')
      GO TO 2000
  384 CALL PPIKR(B,T,ISAVE,NPEEK,NBANDS,SIGLEV)
      IF (NPEAK-NPEEK) 311,350,311
  311 NPEAK=NPEEK
      LPEAK=1
      MM=0
      CRIT=0.0
      GO TO 210
C
C-A STABLE STATE IN THE OPTIMIZING ROUTINE RESUTS IN A BRANCH TO 350.
C-OUTPUT RESULTS.-
C
  350 WRITE (KPRINT,67)
   67 FORMAT('0 M U L T I P L E   B A N D   S P E C T R U M')
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      WRITE (KPRINT,6) RSQ
C
C-CHECK FINAL SPECTRUM FOR EXCESSIVE TOTAL POWER IN SIGNIFICANT BANDS.
C
      CALL TOTAM(X,NOBS,NPEAK,ISAVE,M,PHASE,B,SUMB)
      IF(SUMB-TOPP) 381,382,382
  382 WRITE (KPRINT,383)
  383 FORMAT('1PROGRAM FAILED BY FINDING TOO MUCH POWER IN THE SPECTRUM.
     1',/,'  SUGGEST ALTERING PARAMETERS OF THE ANALYSIS, SUCH AS',/,
     2'   USE WIDER SPECTRUM LIMITS, FILTER DATA, ALTER DELTAP, ETC.')
  381 GO TO 2000
C
```

```
C
C*********************************************************************
C*********************************************************************
C
C
C-STATEMENTS 400-600 INVOLVE COMPUTATION OF THE SIMPLE, SINGLE BAND
C-SPECTRUM ONLY.
C
  400 CALL USPECT(R,T,NOBS,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,BANDS,
     1 AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      GO TO 2000
C
C
C*********************************************************************
C*********************************************************************
C
C
C-STATEMENTS 600-800 INVOLVE COMPUTATION OF A SPECIFIC K-BAND MODEL
C-WITHOUT OPTIMIZATION.
C
C-FIRST READ IN MODEL PARAMETERS, BUILD VECTOR OF BANDS IN MODEL, THEN
C-COMPUTE SPECTRUM.
C
  600 READ (KREADR,1) NPEAK
      READ (KREADR,2) (PEAKS(LPEAK),LPEAK=1,NPEAK)
      DO 610 LPEAK=1,NPEAK
      DO 620 LBAND=1,NBAND
      IF (PEAKS(LPEAK)-BANDS(LBAND)) 620,630,620
  630 ISAVE(LPEAK)=LBAND
      GO TO 610
  620 CONTINUE
  610 CONTINUE
      CALL MULTI(ISAVE,NPEAK,NBANDS,R,T,NOBS,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      WRITE (KPRINT,5)
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,ANAME,TNAME,PHNAME,
     1 BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      WRITE (KPRINT,6) RSQ
 2000 STOP
      END
```

```
C
C
      SUBROUTINE REV(X,N)
      DIMENSION X(50)
C
C *********************************************************************
C *                                                                   *
C *   SUBROUTINE R E V                                                *
C *                                                                   *
C *  REV TAKES A VECTOR AND REVERSES ITS ORDER.                       *
C *                                                                   *
C *********************************************************************
C
      J=N+1
      MID=N/2
      DO 10 L=1,MID
      J=J-1
      SAVE=X(L)
      X(L)=X(J)
   10 X(J)=SAVE
      RETURN
      END
```

```
C
C
      SUBROUTINE DEPVAR(X,NOBS,JDATA,JDOMAN,JPRINT)
      DIMENSION X(1)
      COMMON KREADR
C
C ********************************************************************
C *                                                                  *
C *   SUBROUTINE D E P V A R
C *                                                                  *
C *  DEPVAR EITHER READS IN OR GENERATES (VIA SIMULA), A DEPENDENT   *
C *  VARIABLE VECTOR OF LENGTH NOBS.  THE DEPENDENT VARIABLE IS STORED*
C *  INTO THE FIRST NOBS CELLS OF X, A MATRIX OF VARIABLES STORED AS A*
C *  VECTOR OF COLUMNS.  SEE SUBROUTINE PREGEN FOR REST OF X.        *
C *                                                                  *
C ********************************************************************
C
C-IF JDATA IS 0 - READ FROM CARDS, (10X,7F10.0)
C-IF JDATA IS 1 - CALL SIMULA WHICH GENERATES DATA USING A MONTE CARLO
C-SYSTEM ALONG WITH DETERMINISTIC DATA.  SIMULA READS CARDS.
C
      IF (JDATA) 10,10,50
   10 READ (KREADR,1) (X(L),L=1,NOBS)
    1 FORMAT (10X,7F10.0)
      GO TO 20
   50 CALL SIMULA(X,NOBS,JDATA,JDOMAN,JPRINT)
   20 RETURN
      END
```

```
C
C
      SUBROUTINE PREGEN(X,BANDS,NOBS,NBANDS)
      DIMENSION X(1),BANDS(1)
C
C *********************************************************************
C *                                                                   *
C *   SUBROUTINE P R E G E N
C *                                                                   *
C *  PREGEN GENERATES THE SINE AND COSINE PREDICTOR WAVES AND STORES  *
C *  THEM IN MATRIX X.  MATRIX X IS THE DATA MATRIX HAVING NOBS ROWS  *
C *  AND M COLUMNS.  HERE NOBS= THE NUMBER OF OBSERVATIONS AND        *
C *  BANDS IS A VECTOR OF PERIOD VALUES IN THE SPECTRUM.              *
C *                                                                   *
C *  MATRIX X IS STORED IN VECTOR MODE.   SEE IBM SYSTEM/360 SUB-     *
C *  ROUTINE PACKAGE (360A-CM-03X) VERSION III, PROGRAMMER'S MANUAL,  *
C *  PUBLICATION NUMBER H20-0205-3, PAGES 3-6.  ESSENTIALLY EACH COL- *
C *  UMN OF MATRIX X IS STRUNG END-TO-END INTO ONE LONG VECTOR.       *
C *                                                                   *
C *  THE FIRST NOBS VALUES OF VECTOR (MATRIX) X WILL BE THE DEPENDENT *
C *  VARIABLE (SEE SUBROUTINE DEPVAR).  THE NEXT NOBS POINTS (COLUMN  *
C *  TWO) WILL CONTAIN COS WAVE, BAND 1, THE NEXT NOBS POINTS (COLUMN *
C *  THREE CONTAINS SIN WAVE, BAND 1, ETC.                            *
C *                                                                   *
C *********************************************************************
C
C-CONVERT TO RADIANS/OBSERVATION AND LOOP THRU NBANDS TIMES.
C
      L=NOBS
      DO 10 LBAND=1,NBANDS
      AFREQ=6.28318/BANDS(LBAND)
      EF=-AFREQ
      DO 20 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   20 X(L)=COS(EF)
      EF=-AFREQ
      DO 10 LOBS=1,NOBS
      L=L+1
      EF=EF+AFREQ
   10 X(L)=SIN(EF)
C
C-X CONTAINS THE VECTORS OF SIN/COS WAVES STRUNG END-TO-END.  THIS IS
C-EQUIVALENT TO A MATRIX WHERE EACH SIN OR COS WAVE FORMS A COLUMN OF
C-NOBS LENGTH.
C
      RETURN
      END
```

```
C
C
      SUBROUTINE SIMULA(X,N,J,JDOMAN,JPRINT)
      DIMENSION X(1),A(130),BAND(1)
      COMMON KREADR,KPRINT
C
C ********************************************************************
C *                                                                  *
C *   SUBROUTINE S I M U L A                                         *
C *                                                                  *
C *  SIMULA IS A PRIMATIVE MONTE CARLO AND SIGNAL GENERATOR FOR CREAT-*
C *  ING ARTIFICIAL DATA.  GAUSSIAN DATA ARE READ IN FROM CARDS AND   *
C *  A NUMBER OF SINE WAVES OF VARIABLE FREQUENCY AND AMPLITUDE ARE   *
C *  ADDED.                                                          *
C *                                                                  *
C ********************************************************************
C
C-ZERO VECTOR X AND PRINT HEADING
C
      DO 100 L=1,N
  100 X(L)=0.0
      IF (JPRINT) 110,110,120
  120 WRITE (KPRINT,121)
  121 FORMAT('1M O N T E    C A R L O    SIMULATED DATA',/,'0')
C
C-READ IN MODEL SPECIFICATIONS - GENERATE SINES AND ADD NOISE
C  NSIN-NUMBER OF SINE WAVES IN DATA
C  BAND-FREQ. OR PERIOD OF THE LSINTH SINE WAVE
C  SD-STANDARD DEFIATION OF THE LSINTH SINE WAVE.  (AMPLITUDE)
C  SDN-STANDARD DEV. OF GAUSSIAN NOISE
C
  110 READ (KREADR,1) NSIN
    1 FORMAT (I5)
      DO 10 LSIN=1,NSIN
      READ (KREADR,2) BAND(1),SD
    2 FORMAT (2F10.0)
      IF (JDOMAN)20,20,30
   30 BAN=BAND(1)
      BAND(1)=1.0/BAND(1)
      GO TO 21
   20 BAN=1.0/BAND(1)
   21 IF (JPRINT) 25,25,22
   22 WRITE (KPRINT,3) LSIN, BAND(1), BAN,SD
    3 FORMAT(' BAND',I3,' - PERIOD=',F10.4,', FREQUENCY=',F10.4,', AMPLI
     1TUDE=',F10.4)
   25 AFREQ=6.28318/BAND(1)
      EF=-AFREQ
      DO 26 L=1,N
      EF=EF+AFREQ
   26 A(L)=SIN(EF)*1.41421
      DO 10 L=1,N
   10 X(L)=X(L)+A(L)*SD
C
C-READ IN NOISE SD AND NOISE CARDS
```

```
C
      READ (KREADR,2) SDN
      IF(SDN) 1000,1000,40
   40 IF (JPRINT) 50,50,41
   41 WRITE (KPRINT,5) SDN
    5 FORMAT('ORANDOM GAUSSIAN NOISE AMPLITUDE=',F10.4)
   50 READ (KREADR,6) (A(L),L=1,N)
    6 FORMAT(4X,10F6.4)
      DO 60 L=1,N
   60 X(L)=A(L)*SDN+X(L)
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE MATPRT(R,M,LVAR)
      DIMENSION R(1),X(15),LVAR(1)
      COMMON KREADR, KPRINT
C
C ***********************************************************************
C *                                                                     *
C *   SUBROUTINE M A T P R T                                            *
C *                                                                     *
C *  MATPRT PRINTS OUT THE LOWER TRIANGULAR MATRIX X WHERE X IS STOR-  *
C *  ED IN MODE 1.  SEE REFERENCE LISTED IN SUBROUTINE PREGEN.         *
C *                                                                     *
C ***********************************************************************
C
C-LOOP THRU AS MANY TIMES AS NEEDED TO PRINT WHOLE MATRIX, EACH TIME
C-PRINTING 15 COLUMNS BY NRO ROWS.
C
      N1=1
      N2=15
  110 IF (N2-M) 100,100,10
   10 N2=M
  100 WRITE (KPRINT,1)  (LVAR(LV),LV=N1,N2)
    1 FORMAT('0',2X,15I7)
      WRITE (KPRINT,2)
    2 FORMAT('0')
C
C-PRINT ONE ROW AT A TIME.  MATRIX R IS MODE 1, UPPER TRIANGULAR.
C-THEREFORE REVERSE SUBSCRIPTS TO MAKE LOWER TRIANGULAR.
C
      DO 20 LROW=N1,M
      IF (LROW-N2) 21,21,22
   21 LIMIT=LROW
      GO TO 23
   22 LIMIT=N2
   23 L=0
      DO 30 LCOL=N1,LIMIT
      L=L+1
      CALL LOC(LCOL,LROW,K,M,M,1)
   30 X(L)=R(K)
   20 WRITE (KPRINT,3) (LROW,(X(K),K=1,L))
    3 FORMAT(1X,I3,2X,15F7.3)
      N1=N1+15
      N2=N1+14
      IF (M-N1) 1000,110,110
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE USPECT(R,T,N    ,M,B,NBANDS,STD,JPRINT,JPLOT,PHASE,BAN,
     1 BANDS,AMNAME,TNAME,PHNAME,XNAME,JDOMAN,BANAME)
      DIMENSION R(1),T(1),B(1),STD(1),PHASE(1),BAN(1),BANDS(1),AMNAME(1)
     1,TNAME(1),PHNAME(1),XNAME(1),BANAME(1)
      COMMON KREADR,KPRINT
C
C *******************************************************************
C *                                                                 *
C     SUBROUTINE U S P E C T
C *                                                                 *
C *  USPECT COMPUTES THE UNIVARIATE SPECTRUM BY MULTIPLYING THE CORR- *
C *  ELATION OF THE TIME SERIES WITH A SIN OR COS PREDICTOR BY THE    *
C *  RATIO OF STANDARD DEVIATIONS OF THE TWO.  THIS IS DONE FOR EACH  *
C *  PREDICTOR.  LET R=THE CORRELATION OF F(T) WITH A SIN OR COS WAVE *
C *  OF SOME ARBITRARY WAVE LENGTH.  LET   S =THE STANDARD DEVIATION  *
C *  OF THE TIME SERIES AND .707=THE STANDARD DEVIATION OF THE PRED-  *
C *  ICTOR WAVE.  THEN  A(F) = R*(S/.707)                             *
C *  WHERE A(F)=THE AMPLITUDE OF THE COMPLEX SPECTRUM AT F.  THE SIN  *
C *  AND COS COMPONENTS ARE COMBINED AT EACH WAVE LENGTH AND PHASE    *
C *  ANGLE IS COMPUTED.  T-VALUES ARE ALSO COMPUTED FOR EACH BAND.    *
C *  R=UPPER TRIANGULAR CORRELATION MATRIX, IN STORAGE MODE 1.  SEE   *
C *  IBM PUBLICATION REFERENCED IN SUBROUTINE PREGEN.  (INPUT)        *
C *  T=VECTOR OF T-VALUES.  (OUTPUT)                                  *
C *  NOBS=NUMBER OF OBSERVATIONS.  (INPUT)                            *
C *  M=TOTAL NUMBER OF DATA VECTORS.  M=NBANDS*2 + 1.  ONE VECTOR FOR *
C *  THE DEPENDENT VARIABLE AND TWO FOR THE SIN/COS WAVES AT EACH WAVE*
C *  LENGTH.  (INPUT).  B=VECTOR OF SPECTRUM ESTIMATES.  (OUTPUT)     *
C *  NBANDS=LENGTH OF VECTORS T,B AND PHASE.  (INPUT)                 *
C *  STD=STANDARD DEVIATIONS OF ALL VARIABLES.  (INPUT)               *
C *  JPRINT=PRINT CONTROL - SEE MAINLINE.  (INPUT)                    *
C *  JPLOT=PLOT CONTROL - SEE MAINLINE.  (INPUT)                      *
C *  PHASE=VECTOR OF PHASE ANGLES.  (OUTPUT)                          *
C *                                                                 *
C *******************************************************************
      LBAND=0
C
C-EXTRACT VECTOR OF CORRELATIONS BETWEEN DEPENDENT VARIABLE AND EACH
C-PREDICTOR VARIABLE.
C
      DO 10 L=2,M
      CALL LOC(1,L,KOOL,M,M,1)
   10 B(L)=R(KOOL)
C
C-LOOP THRU THE SPECTRUM COMPUTATION NBAND TIMES.
C
      FACT=SQRT(FLOAT(N-2))
      DO 20 L=2,M,2
      K=L+1
      LBAND=LBAND+1
C
C-CO=COS COMPONENT OF SPECTRUM ESTIMATE
C-SI=SIN COMPONENT OF SPECTRUM ESTIMATE
```

```
C-TC=T-VALUE FOR COS COMPONENT
C-TS=T-VALUE FOR SIN COMPONENT
C
      CO=B(L)*STD(1)/.707
      SI=B(K)*STD(1)/.707
      TC=B(L)*FACT/SQRT(1.0-B(L)**2)
      TS=B(K)*FACT/SQRT(1.0-B(K)**2)
C
C-COMPUTE SPECTRUM AMPLITUDE, T-VALUE AND PHASE ANGLE
C
      B(LBAND)=SQRT(CO**2 + SI**2)
      T(LBAND)=SQRT(TC**2 + TS**2)
   20 PHASE(LBAND)=ATAN(CO/SI)
C
C-PRINT AND/OR PLOT IF DESIRED
C
      JPR=JPRINT-1
      JPL=JPLOT-1
      IF (JPR) 50,50,60
   50 IF (JPL) 1000,1000,60
   60 WRITE(KPRINT,1)
    1 FORMAT('0 S I N G L E    B A N D    S P E C T R U M')
      CALL OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME
     1,BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
 1000 RETURN
      END
```

```
C
C
      SUBROUTINE PPIKR(B,T,ISAVE,NPEAK,NBANDS,SIGLEV)
      DIMENSION B(1),T(1),ISAVE(1)
C
C ***********************************************************************
C *                                                                     *
C *    SUBROUTINE P P I K R                                             *
C *                                                                     *
C *  PPIKR RETURNS THE VECTOR INDEX OF ALL SIGNIFICANT SPECTRUM PEAKS.*
C *  B-INPUT VECTOR OF AMPLITUDE SPECTRUM ESTIMATES                     *
C *  T-INPUT VECTOR OF T-VALUES FOR EACH SPECTRUM ESTIMATE              *
C *  ISAVE-OUTPUT VECTOR OF INDEX NUMBERS OF SIGNIFICANT PEAKS          *
C *  NPEAK-OUTPUT SCALAR - NUMBER OF PEAKS FOUND                        *
C *  NBANDS-INPUT SCALAR - NUMBER OF BANDS IN SPECTRUM                  *
C *  SIGLEV-INPUT SCALAR - CRITERION WHICH T-VALUE FOR A PEAK MUST      *
C *          EXCEED IN ORDER TO BE RETAINED                             *
C *                                                                     *
C ***********************************************************************
C
C-SEARCH FOR PEAKS, RETAIN 'SIGNIFICANT' ONES, BUILD ISAVE.
C
      NPEAK=0
      DO 10 L=2,NBANDS
      IF (B(L-1)-B(L)) 20,10,10
   20 IF (B(L+1)-B(L)) 40,10,10
   40 IF (T(L)-SIGLEV) 10,50,50
   50 NPEAK=NPEAK+1
      ISAVE(NPEAK)=L
   10 CONTINUE
      RETURN
      END
```

```
C
C
      FUNCTION CRITR(RSQ,T,JCRITR,L)
      DIMENSION T(1)
C
C ******************************************************************
C *                                                                *
C *   FUNCTION C R I T R                                           *
C *                                                                *
C *  CRITR SELECTS A CRITERION FOR THE SPECTRUM OPTIMIZATION BY PEAK  *
C *  SHIFTING.  SELECTS EITHER R-SQUARE OR THE APPROPRIATE T VALUE.   *
C *                                                                *
C ******************************************************************
C
C-SELECT APPROPRIATE VALUE FOR CRITERION.
C  RSQ-INPUT SCALAR - VALUE OF R-SQUARE
C  T-INPUT VECTOR - T-VALUES
C  JCRITR-CONTROL DIGIT FOR SELECTION OF EITHER RSQ OR T(L) AS CRITERION
C         0=RSQ AS CRITERION
C         1=T-VALUE AS CRITERION
C  L-INDEX VALUE OF VECTOR T
C
      IF (JCRITR) 10,10,20
   10 CRITR=RSQ
      GO TO 30
   20 CRITR=T(L)
   30 RETURN
      END
```

```
C
C
      SUBROUTINE KSPECT(R,T,N,M,NPEAK,ISAV ,RX,B,JPRINT,XBAR,STD,D,RSQ,
     1PHASE, BANDS,BAN)
      DIMENSION ISAVE(100)    ,R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),
     1PHASE(1),BANDS(1),BAN(1)                    ,ANS(10),ISAV(1),RY(100)
      COMMON KREADR,KPRINT
C-CONVERT ISAV TO ISAVE, FROM FREQ BAND VECTOR TO VECTOR OF SIN/COS PAIR
C
98521 FORMAT ('OJKL=',I5)
      K=0
      DO 100 L=1,NPEAK
      K=K+1
      ISAVE(K)=ISAV(L)*2
      K=K+1
  100 ISAVE(K)=ISAVE(K-1)+1
C
C-SELECT SUB-MATRIX OF PREDICTORS ETC FROM R, ACCORDING TO ISAVE.
C
      CALL ORDER(M,R,1,K     ,ISAVE,RX,RY)
C
C-INVERT K-ORDER MATRIX OF PREDICTOR INTERCORRELATIONS, RX
C
      CALL MINV(RX,K,DET,B,T)
      IF (JPRINT-3) 300,400,400
  400 WRITE (KPRINT,7) DET
    7 FORMAT('0',/,'0 DETERMINANT =',E30.15)
C
C-COMPUTE REGRESSIONS(SPECTRUM) FOR NPEAK SIZED MODEL.
C
  300 CALL MULTR(N,K,XBAR,STD,D,RX,RY,ISAVE,B,SB,T,ANS)
      RSQ=ANS(2)**2
C
C-CONVERT SPECTRUM TO AMPLITUDES BY COMBINING SIN/COS.  PUT INTO D.
C-ALSO CONVERT T.
C
      NFREQ=0
      DO 200 L=1,K,2
      NFREQ=NFREQ+1
      PHASE(NFREQ)=ATAN(B(L)/B(L+1))
      B(NFREQ)=SQRT(B(L)**2 + B(L+1)**2)
  200 T(NFREQ)=SQRT(T(L)**2 + T(L+1)**2)
   10 RETURN
      END
```

```
C
C
      SUBROUTINE MULTI(ISAVE,NPEAK,NBANDS,R,T,N,M,RX,B,XBAR,STD,D,RSQ,
     1 PHASE,BANDS,BAN)
      DIMENSION ISAVE(1),R(1),T(1),RX(1),B(1),XBAR(1),STD(1),D(1),PHASE
     1 (1),BANDS(1),BAN(1),KSAVE(20),S(20),TSPEC(20),TPH(20)
      COMMON KREADR,KPRINT
C
C ***********************************************************************
C *                                                                     *
C *    SUBROUTINE M U L T I                                             *
C *                                                                     *
C *  MULTI COMPUTES THE FULL SPECTRUM OF A TIME SERIES USING A K+1      *
C *  BANDS    MODEL WHERE K=THE NUMBER OF PEAKS IN THE OPTOMIZED        *
C *  MODEL.  THE EXTRA BAND IS THE WAVELENGTH IN QUESTION, THE OTHERS   *
C *  ARE THE SIGNIFICANT PEAKS.  THE VARIANCE ACCOUNTED FOR BY          *
C *  THE SIGNIFICANT PEAKS IS THUS 'ACCOUNTED FOR' IN EACH ESTIMATE.    *
C *  WHEN THE CURRENT BAND IS ONE OF THE SIGNIFICANT PEAKS, A SKIP      *
C *  OCCURS.  VARIABLES DEFINED IN MAINLINE.                            *
C *                                                                     *
C ***********************************************************************
C
C
C-LOOP THRU ONCE FOR EACH FREQ BAND.  NFMOD IS THE NUMBER OF SIGNICIC-
C-CANT PEAKS IN MODEL PLUS A CURRENT BAND.
C
      NFMOD=NPEAK+1
      DO 310 LF=1,NBANDS
C
C-CONSTRUCT NEW ISAVE VECTOR
C
      CALL BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
C
C-SKIP IF THIS BAND IS IN THE MODEL ALREADY
C
      IF (ISKIP) 320,320,330
C
C-BRANCH TO 330 IMPLIES THAT THE CURRENT BAND IS ONE OF THE SIGNIFICANT
C-PEAKS.  DO AN NPEAK SPECTRUM AND PICK OUT CURRENT BAND.
C
  330 CALLKSPECT(R,S,N,M,NPEAK,ISAVE,RX,TSPEC,O,XBAR,STD,D,RSQ,TPH,
     1BANDS,BAN)
C
C-TSPEC CONTAINS ALL MODEL ESTIMATES.  PICK THE ONE FOR LF.
C
      DO 331 LLZ=1,NPEAK
      IF (LF-ISAVE(LLZ)) 331,333,331
  333 B(LF)=TSPEC(LLZ)
      PHASE (LF)=TPH(LLZ)
      T(LF)=S(LLZ)
  331 CONTINUE
      GO TO 310
C
C-BRANCH TO 320 IMPLIES THAT THIS IS A FULL NFMOD MODEL.  DO SPECTRUM
```

```
C-AND PICK OUT CURRENT BAND.
C
  320 CALLKSPECT(R,S,N,M,NFMOD,KSAVE,RX,TSPEC,O,XBAR,STD,D,RSQ,TPH,
     1 BANDS,BAN)
      DO 321 LLL=1,NFMOD
      IF(LF-KSAVE(LLL)) 321,322,321
  322 T(LF)=S(LLL)
      B(LF)=TSPEC(LLL)
      PHASE (LF)=TPH(LLL)
  321 CONTINUE
  310 CONTINUE
      RETURN
      END
```

```
C
C
      SUBROUTINE BUILD(KSAVE,ISAVE,LF,NFMOD,ISKIP,NPEAK)
      DIMENSION KSAVE(1),ISAVE(1),ASAVE(30),RANC(30)
C
C ***********************************************************************
C *                                                                     *
C     SUBROUTINE B U I L D
C *   BUILD CONSTRUCTS VECTOR OF RANKED FREQ BAND NUMBERS GIVEN A       *
C *   PARTICULAR MODEL AND A CURRENT FREQUENCY.                         *
C *   KSAVE - OUTPUT VECTOR TO BE BUILT                                 *
C *   ISAVE - INPUT VECTOR CONTAINING NFREQ SIGNIF PEAKS                *
C *   LF - INPUT SCALAR - NEW FREQ BAND TO BE ADDED (CURRENT ONE)       *
C *   NFMOD - INPUT - NUMBER OF FREQ BANDS IN NEW MODEL                 *
C *   ISKIP - OUTPUT CONTROL DIGIT TO KEEP FROM COMPUTING ESTIMATE      *
C *            OF ONE OF THE OLD PEAKS AGAIN                            *
C *   NPEAK - INPUT - NUMBER OF FREQ BANDS IN OLD MODEL                 *
C *                                                                     *
C ***********************************************************************
C
C-SEE IF LF IS ALREADY IN MODEL
C
      DO 10 L=1,NPEAK
      IF(LF - ISAVE(L)) 10,99,10
   10 CONTINUE
C
C-STORE VECTOR OF ISAVE PLUS LF INTO ASAVE AND RANK IT.  RANK STORED IN
C-VECTOR RANC
C
      DO 20 L=1,NPEAK
   20 ASAVE(L)=ISAVE(L)
      ASAVE(NFMOD)=LF
      CALL RANK(ASAVE,RANC,NFMOD)
C
C-BUILD KSAVE OF RANKED FREQ BANDS
C
      DO 30 L=1,NFMOD
      KOOL=RANC(L)
   30 KSAVE(KOOL)=ASAVE(L)
      ISKIP=0
      GO TO 100
   99 ISKIP=1
  100 RETURN
      END
```

```
C
C
      SUBROUTINE OUTPUT(BANDS,BAN,B,T,PHASE,NBANDS,AMNAME,TNAME,PHNAME,
     1BANAME,XNAME,JPRINT,JPLOT,JDOMAN)
      DIMENSION BANDS(1),BAN(1),B(1),T(1),PHASE(1),AMNAME(1),TNAME(1),
     1PHNAME(1),BANAME(1),XNAME(1)
      COMMON KREADR,KPRINT
C
C ***********************************************************************
C *                                                                     *
C *   SUBROUTINE O U T P U T                                            *
C *                                                                     *
C *  OUTPUT PRINTS AND/OR PLOTS SPECTRA WITH DOCUMENTATION.             *
C *                                                                     *
C ***********************************************************************
C
C-PRINT OUT DOCUMENTATION AND VECTOR ORDER IN APPROPRIATE DOMAIN)
C-FIND SCALE VALUES AND PLOT
C
      TOPI=6.28318
      BTOPI=-TOPI
      BMAX=B(1)
      DO 64 LBAND=2,NBANDS
      IF (BMAX-B(LBAND)) 68,64,64
   68 BMAX=B(LBAND)
   64 CONTINUE
      TMAX=T(1)
      DO 66 LBAND=2,NBANDS
      IF (TMAX-T(LBAND)) 67,66,66
   67 TMAX=T(LBAND)
   66 CONTINUE
      IF (JDOMAN) 60,60,50
C
C-REVERSE VECTORS IF FREQ DOMAIN IS USED - PRINT - REVERSE AGAIN.
C
   50 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      IF (JPRINT) 52,52,51
   51 WRITE (KPRINT,2)
    2 FORMAT('OFREQUENCY ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 55 LBAND=1,NBANDS
   55 WRITE (KPRINT,3) BAN(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
    3 FORMAT(F10.3,5X,F9.3,5X,F7.3,5X,F8.3)
   52 IF (JPLOT) 54,54,53
   53 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BAN,AMNAME,TNAME,BANAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BAN,PHNAME,TNAME,
     1 BANAME)
   54 CALL REV(B,NBANDS)
      CALL REV(T,NBANDS)
      CALL REV(PHASE,NBANDS)
      GO TO 100
   60 IF (JPRINT) 62,62,61
   61 WRITE (KPRINT,4)
```

```
    4 FORMAT('OPERIOD     ',5X,'AMPLITUDE',5X,'T-VALUE',8X,'PHASE',/,'0')
      DO 65 LBAND=1,NBANDS
   65 WRITE (KPRINT,3) BANDS(LBAND),B(LBAND),T(LBAND),PHASE(LBAND)
   62 IF (JPLOT) 100,100,63
   63 CALL PLOT2(B,BMAX,0.0,T,TMAX,0.0,NBANDS,BANDS,AMNAME,TNAME,XNAME)
      CALL PLOT2(PHASE,TOPI,BTOPI,T,TMAX,0.0,NBANDS,BANDS,PHNAME,TNAME,
     1 XNAME)
  100 RETURN
      END
```

```
C
C
      SUBROUTINE PLOT2(Y1,YMAX1,YMIN1,Y2,YMAX2,YMIN2,NP,XAX,YNAM1,
     1 YNAM2,XNAM)
      DIMENSION Y1(1),Y2(1),LINE(111),XAX(1),XNAM(5),YNAM1(9),YNAM2(9)
      COMMON KREADR,KPRNT
      DATA KBLNK/' '/,KBORD/'.'/,KAL/'+'/,KPLOT/'*'/
C
C--PLOT2 GENERATES TWO OVER/UNDER     GRAPHS PER PAGE AND CALIBRATES
C--THEM. Y1=VERTICAL VARIABLE 1, YMAX1, YMIN1=VERTICAL PLOT LIMITS.
C--Y2, YMAX2, YMIN2=SIMILAR FOR SECON VARIABLE, NP=NUMBER OF POINTS,
C--XAX=X AXIS (COMMON TO BOTH VARIABLES).
      WRITE (KPRNT,2)       YNAM1,YNAM2,XNAM
    2 FORMAT('1'      / T5,'*'/ T5,'*',T25,'*',T80,'*'/ T5,'*',T25,'***'
     1,T80,'***'/ T3,'*****',T18,'************ ',9A4,T73,'************ '
     2,9A4/T4,'***',T25, '***', T80,'***'/T5,'*',T25,'*',T80,'*'/1X,5A4)
C
C--GENERATE SCALE FACTORS
      SKAL1=50.5/(YMAX1-YMIN1)
      SKAL2=50.5/(YMAX2-YMIN2)
C--GENERATE CALIBRATION AND OUTPUT IT.
      CAL01 = YMIN1
      CAL02 = YMIN2
      CAL1 = YMAX1
      CAL2 = YMAX2
      CAL51=YMAX1-(.5*(YMAX1-YMIN1))
      CAL52=YMAX2-(.5*(YMAX2-YMIN2))
      WRITE (KPRNT,1) CAL01,CAL51,CAL1,CAL02,CAL52,CAL2
    1 FORMAT (' ',F14.4,F24.4,F23.4,F12.4,F23.4,F24.4)
C--GENERATE VERTICAL AXIS AND OUTPUT IT
      DO 10 L = 1,111
   10 LINE(L) = KBORD
      LINE(1) = KAL
      LINE(26) = KAL
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
      DO 20 L=52,60
   20 LINE(L) = KBLNK
      WRITE(KPRNT,4) LINE
    4 FORMAT(10X,111A1)
C
C--DECIDE HOW MANY LINES BETWEEN POINTS
      NWIDE = 32/NP
C
C--LOOP FOR NUMBER OF POINTS, EACH TIME PLOTTING A POINT AND NWIDE SPACE
      DO 30 LP = 1, NP
C
C--CLEAR LINE AND GENERATE GRID POINTS
      DO 40 L = 1,111
   40 LINE(L) = KBLNK
      LINE (1)=KBORD
      LINE(26)=KBORD
```

```
      LINE(51)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--TEST FOR OVER OR UNDER RANGE AND TRUNCATE OUT-OF-BOUNDS VALUES
      IF (Y1(LP)-YMAX1) 2000, 2000, 2100
 2100 YA      = YMAX1
      GO TO 5100
 2000 IF(Y1(LP)-YMIN1)5000, 5200, 5200
 5000 YA      = YMIN1
      GO TO 5100
 5200 YA=Y1(LP)
 5100 IF (Y2(LP)-YMAX2) 200, 200, 210
  210 YB      = YMAX2
      GO TO 510
  200 IF (Y2(LP)-YMIN2) 500, 520, 520
  500 YB      = YMIN2
      GO TO 510
  520 YB=Y2(LP)
C
C--NOW GENERATE POINT INDEXES
  510 K1 = (YA     -YMIN1)*SKAL1+1.0
      K2 = (YB     -YMIN2)*SKAL2+61.0
      LINE(K1)= KPLOT
      LINE(K2)= KPLOT
C
C--OUTPUT HORIZONTAL SCALE VALUE AND LINE
      WRITE (KPRNT ,3) XAX(LP),LINE
    3 FORMAT (1X,F 8.4,1X,111A1)
C
C--CLEAR LINE AND GENERATE BLANK LINES FOR SPACE
      IF (NWIDE) 30,30,110
  110 DO 95 L=1,111
   95 LINE(L)=KBLNK
      LINE (1)=KBORD
      LINE(51)=KBORD
      LINE(26)=KBORD
      LINE(61)=KBORD
      LINE(86)=KBORD
      LINE(111)=KBORD
C
C--OUTPUT PLAIN LINE
      DO 90 LOOP=1,NWIDE
   90 WRITE (KPRNT,4) LINE
   30 CONTINUE
C
C--GENERATE RIGHT BORDER AND OUTPUT
      DO 50 L = 1,111
   50 LINE(L) = KBORD
      LINE(1) = KAL
      LINE(26) = KAL
      LINE(51) = KAL
      LINE(61) = KAL
      LINE(86) = KAL
      LINE(111)= KAL
```

```
      DO 80 L= 52,60                                                    PLT21110
   80 LINE (L) = KBLNK                                                  PLT21120
      WRITE (KPRNT,4) LINE                                              PLT21130
      RETURN                                                            PLT21140
      END                                                               PLT21150
```

```
C
C
      SUBROUTINE TOTAM(X,N,NPEAK,ISAVE,M,PHASE,B,AMP)
      DIMENSION X(1),ISAVE(1),PHASE(1),B(1)
C
C ******************************************************************
C *                                                                *
C *   SUBROUTINE T O T A M                                         *
C *                                                                *
C *   TOTAM COMPUTES THE RESULTANT AMPLITUDE OF THE SUM OF NPEAK SIN- *
C *   SOIDS WHICH HAVE THEIR AMPLITUDES AND PHASES DETREMINED BY THE  *
C *   CALLING PROGRAM..  TOTAM SIMPLY SELECTS THE APPROPRIATE SINE    *
C *   AND COSINE WAVES FROM X, WEIGHTS THEM, SUMS THEM AND THEN COM-  *
C *   PUTES THE AMPLITUDE OF THE SUM.                                *
C *   W A R N I N G    -------     THIS WILL DESTROY ROW 1 OF X WHICH *
C *   CONTAINS THE ORIGINAL DEPENDENT VARIABLE.                      *
C *                                                                *
C ******************************************************************
C
C-LOOP THRU THE FOLLOWING NPEAK TIMES TO CREATE THE RESULTANT WAVE INX
C
      DO 100 LP=1,NPEAK
      K=ISAVE(LP)
      KC=K*2
      KS=KC+1
C
C-THE FOLLOWING COMPUTES THE PROPER AMPLITUDES FOR THE COSINE AND SINE
C-COMPONENTS, BASED ON PHASE AND AMPLITUDE ESTIMATES.
C
      PC=1.0
      PC=PC/(TAN(PHASE(K))+ PC)
      PS=PC*TAN(PHASE(K))
C
C-SELECT SINE AND COSIND VALUES FROM X A
C-SELECT SINE AND COSINE VALUES FROM X, SUM AND PUT INTO X, ROW 1.
C
      DO 100 L=1,N
      CALL LOC(KC,L,J,M,N,0)
      CALL LOC(KS,L,I,M,N,0)
  100 X(L)=X(J)*PC + X(I)*PS
C
C-COMPUTE APLLITUDE OF RESULTANT
C
      SX=0.0
      DO 10 L=1,N
   10 SX=SX+X(L)
      SX=SX/FLOAT(N)
      SXS=0.0
      DO 20 L=1,N
   20 SXS=SXS+(X(L)-SX)**2
      AMP=SQRT(SXS/FLOAT(N))
      RETURN
      END
```

```
SUBROUTINE DATA
RETURN
END
```

APPENDIX 2

Three Examples of Use of SPECT

NOTE:

In Test 1, as in other tests, it will be noted that the final amplitude spectrum has values around the maxima which are not zero. However, the t-spectra always have only two (or the correct number) of peaks. Amplitude spectra should be interpreted by considering the t-values.

T E S T   1.

```
THE FOLLOWING IS A LISTING OF THE CONTRCL AND DATA CARDS FOR TEST 1.
OUTPUT FOLLOWS.

    0     0    20   100     0     1     0     3     2
 19.0       0.5
    2
 22.0       1.0
 25.0       1.0
  1.0
    1 -3180 -7990-13340 13910  3820  7330  6530  2190 -6810 11290
    2-13770-12570  4950 -1390 -8540  4280-13220 -3150 -7320-13480
    3 23340 -3370-19550 -6360-13180 -4330  5450  4280 -2970  2760
    4-11360  6420 34360-16670  5470-11730 -3550   350  3597  9300
    5  4140  -110  6660-11320 -4100-10770  7340 14840 -3400  7890
    6 -4940  3640-12370  -440 -1110 -2100  9310  6160 -3770 -4330
    7 10480   370  7590  6090-20430 -2900  4040 -5430  4860  8690
    8  3470 28160 -4640 -6320-16140  3720  -740 -9160 13140  -380
    9  6370  5630 -1070  1310-18080-11260  3790  6100 -3640-26260
   10 21760  3930 -9240 19110-10400-11680  4850   760 -7690 16070
```

1

SUPE

```
* * * * * * *  PROGRAM PARAMETERS  * * * * * * * *
  0    0   20  100    0    1    0    3    2

M O N T E    C A R L O    SIMULATED DATA

BAND  1 - PERIOD=   22.0000, FREQUENCY=    0.0455, AMPLITUDE=     1.0000
BAND  2 - PERIOD=   25.0000, FREQUENCY=    0.0400, AMPLITUDE=     1.0000

RANDOM GAUSSIAN NOISE AMPLITUDE=     1.0000

SUPR       TIME---1:12.7
```

370/165

```
SUPR       TIME---6:08.3
```

360/50

11

M A T R I X   O F   C O R R E L A T I O N S

VARIABLE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAVES OF VARIOUS PERIODS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000														
2	-0.389	1.000													
3	0.056	0.000	1.000												
4	-0.453	0.658	0.631	1.000											
5	0.299	-0.597	0.686	0.035	1.000										
6	-0.339	0.113	0.714	0.739	0.594	1.000									
7	0.556	-0.658	0.104	-0.559	0.706	-0.000	1.000								
8	-0.231	-0.073	0.591	0.486	0.716	0.935	0.306	1.000							
9	0.639	-0.527	-0.103	-0.689	0.441	-0.302	0.936	0.004	1.000						
10	-0.100	-0.171	0.414	0.222	0.718	0.757	0.551	0.937	0.306	1.000					
11	0.689	-0.366	-0.212	-0.704	0.192	-0.530	0.774	-0.277	0.944	0.025	1.000				
12	0.036	-0.186	0.238	0.001	0.626	0.520	0.697	0.774	0.544	0.944	0.309	1.000			
13	0.706	-0.215	-0.232	-0.628	-0.007	-0.664	0.555	-0.502	0.794	-0.250	0.947	0.034	1.000		
14	0.161	-0.144	0.103	-0.145	0.490	0.283	0.742	0.563	0.690	0.803	0.532	0.952	0.297	1.000	
15	0.686	-0.097	-0.182	-0.491	-0.138	-0.699	0.314	-0.644	0.578	-0.479	0.799	-0.240	0.947	0.023	1.000
16	0.269	-0.075	0.024	-0.213	0.347	0.082	0.708	0.346	0.748	0.615	0.677	0.828	0.510	0.957	0.272
17	0.630	-0.025	-0.094	-0.328	-0.195	-0.645	0.093	-0.694	0.337	-0.631	0.587	-0.469	0.804	-0.245	0.950
18	0.357	-0.000	0.000	-0.216	0.221	-0.067	0.616	0.149	0.726	0.407	0.741	0.650	0.657	0.840	0.484
19	0.551	-0.000	-0.000	-0.176	-0.192	-0.533	-0.078	-0.662	0.116	-0.697	0.358	-0.623	0.607	-0.463	0.820
20	0.419	0.063	0.020	-0.169	0.124	-0.157	0.486	-0.011	0.641	0.205	0.727	0.443	0.729	0.664	0.638
21	0.463	-0.011	0.077	-0.061	-0.148	-0.400	-0.186	-0.578	-0.056	-0.689	0.150	-0.700	0.399	-0.614	0.646
22	0.454	0.104	0.068	-0.092	0.065	-0.189	0.344	-0.121	0.512	0.031	0.649	0.235	0.726	0.458	0.719
23	0.377	-0.043	0.127	0.010	-0.086	-0.271	-0.234	-0.468	-0.171	-0.629	-0.017	-0.709	0.205	-0.696	0.457
24	0.463	0.119	0.126	-0.008	0.041	-0.175	0.212	-0.178	0.370	-0.098	0.531	0.054	0.663	0.254	0.731
25	0.297	-0.086	0.146	0.039	-0.021	-0.161	-0.233	-0.349	-0.230	-0.533	-0.134	-0.663	0.042	-0.713	0.271
26	0.454	0.112	0.179	0.065	0.046	-0.130	0.109	-0.190	0.238	-0.177	0.402	-0.083	0.566	0.077	0.690
27	0.225	-0.127	0.137	0.031	0.037	-0.077	-0.193	-0.236	-0.238	-0.417	-0.201	-0.573	-0.083	-0.674	0.103
28	0.435	0.090	0.220	0.119	0.070	-0.072	0.040	-0.168	0.133	-0.210	0.281	-0.173	0.455	-0.059	0.614
29	0.161	-0.159	0.104	-0.004	0.078	-0.024	-0.128	-0.138	-0.205	-0.295	-0.221	-0.456	-0.164	-0.588	-0.035
30	0.410	0.059	0.244	0.149	0.104	-0.012	0.006	-0.126	0.059	-0.206	0.180	-0.217	0.346	-0.152	0.519
31	0.109	-0.176	0.057	-0.052	0.100	-0.001	-0.054	-0.064	-0.145	-0.182	-0.201	-0.328	-0.201	-0.474	-0.133
32	0.383	0.025	0.249	0.156	0.141	0.042	0.001	-0.073	0.017	-0.174	0.104	-0.223	0.247	-0.204	0.417
33	0.069	-0.178	0.007	-0.104	0.103	-0.004	0.016	-0.018	-0.074	-0.090	-0.156	-0.209	-0.202	-0.350	-0.191
34	0.354	-0.007	0.237	0.143	0.173	0.083	0.021	-0.016	0.004	-0.123	0.054	-0.197	0.164	-0.217	0.315
35	0.042	-0.167	-0.039	-0.149	0.091	-0.023	0.073	0.003	-0.004	-0.025	-0.097	-0.109	-0.176	-0.235	-0.212
36	0.296	-0.052	0.173	0.073	0.209	0.120	0.099	0.077	0.046	-0.001	0.029	-0.087	0.061	-0.156	0.143
37	0.014	-0.124	-0.099	-0.204	0.041	-0.086	0.135	-0.012	0.100	0.028	0.018	0.012	-0.084	-0.062	-0.177
38	0.250	-0.061	0.092	-0.012	0.202	0.100	0.183	0.119	0.127	0.096	0.071	0.036	0.039	-0.042	0.047
39	0.008	-0.071	-0.108	-0.204	-0.015	-0.145	0.129	-0.068	0.139	0.002	0.096	0.036	0.014	0.019	-0.086
40	0.223	-0.043	0.030	-0.074	0.168	0.052	0.236	0.115	0.201	0.142	0.138	0.122	0.071	0.063	0.025
41	0.012	-0.027	-0.075	-0.158	-0.056	-0.175	0.074	-0.129	0.116	-0.065	0.119	-0.009	0.082	0.018	0.013

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	1.000														
17	0.005	1.000													
18	0.959	0.251	1.000												
19	-0.246	0.956	0.000	1.000											
20	0.842	0.465	0.959	0.246	1.000										
21	-0.451	0.844	-0.233	0.963	0.013	1.000									
22	0.670	0.624	0.845	0.459	0.961	0.254	1.000								
23	-0.557	0.688	-0.428	0.863	-0.207	0.966	0.034	1.000							
24	0.473	0.714	0.684	0.616	0.856	0.457	0.965	0.261	1.000						

M A T R I X   O F   C O R R E L A T I O N S

VARIABLE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAVES OF VARIOUS PERIODS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000														
2	-0.221	1.000													
3	-0.047	0.028	1.000												
4	-0.306	0.892	0.415	1.000											
5	-0.017	-0.376	0.880	0.010	1.000										
6	-0.389	0.627	0.664	0.901	0.383	1.000									
7	0.056	-0.637	0.590	-0.373	0.893	0.000	1.000								
8	-0.445	0.298	0.731	0.641	0.642	0.902	0.371	1.000							
9	0.165	-0.714	0.267	-0.623	0.644	-0.352	0.911	0.021	1.000						
10	-0.453	0.012	0.637	0.320	0.733	0.658	0.631	0.912	0.373	1.000					
11	0.299	-0.640	0.003	-0.713	0.346	-0.597	0.686	-0.318	0.918	0.035	1.000				
12	-0.414	-0.163	0.465	0.047	0.681	0.370	0.739	0.701	0.619	0.926	0.358	1.000			
13	0.438	-0.467	-0.158	-0.651	0.070	-0.698	0.390	-0.571	0.697	-0.303	0.918	0.020	1.000		
14	-0.339	-0.221	0.286	-0.131	0.543	0.113	0.714	0.441	0.733	0.739	0.594	0.934	0.327	1.000	
15	0.556	-0.263	-0.207	-0.488	-0.123	-0.658	0.104	-0.691	0.406	-0.559	0.706	-0.307	0.924	-0.000	1.000
16	-0.231	-0.185	0.143	-0.204	0.370	-0.073	0.591	0.183	0.720	0.486	0.716	0.753	0.567	0.935	0.306
17	0.639	-0.097	-0.169	-0.299	-0.211	-0.527	-0.103	-0.682	0.134	-0.689	0.441	-0.549	0.737	-0.302	0.936
18	-0.100	-0.092	0.057	-0.185	0.205	-0.171	0.414	-0.025	0.605	0.222	0.718	0.501	0.703	0.757	0.551
19	0.689	0.001	-0.089	-0.139	-0.211	-0.366	-0.212	-0.587	-0.068	-0.704	0.192	-0.682	0.502	-0.530	0.774
20	0.036	0.013	0.031	-0.110	0.084	-0.186	0.238	-0.154	0.440	0.001	0.626	0.243	0.728	0.520	0.697
21	0.706	0.031	-0.002	-0.035	-0.152	-0.215	-0.232	-0.444	-0.185	-0.628	-0.007	-0.707	0.264	-0.664	0.555
22	0.161	0.096	0.050	-0.018	0.022	-0.144	0.103	-0.204	0.276	-0.145	0.490	0.030	0.669	0.283	0.742
23	0.686	0.005	0.067	0.010	-0.063	-0.097	-0.182	-0.288	-0.218	-0.491	-0.138	-0.640	0.255	-0.699	0.314
24	0.269	0.144	0.094	0.062	0.013	-0.075	0.024	-0.191	0.146	-0.213	0.347	-0.118	0.560	0.082	0.708
25	0.630	-0.053	0.105	0.003	0.024	-0.025	-0.094	-0.148	-0.185	-0.328	-0.195	-0.509	-0.099	-0.645	0.093
26	0.357	0.153	0.145	0.116	0.042	-0.000	0.000	-0.136	0.062	-0.216	0.221	-0.195	0.429	-0.067	0.616
27	0.551	-0.118	0.109	-0.038	0.090	-0.000	-0.000	-0.046	-0.113	-0.176	-0.192	-0.354	-0.187	-0.533	-0.078
28	0.419	0.128	0.188	0.137	0.093	0.063	0.020	-0.060	0.025	-0.169	0.124	-0.209	0.296	-0.157	0.486
29	0.463	-0.172	0.088	-0.091	0.125	-0.011	0.077	0.010	-0.031	-0.061	-0.148	-0.210	-0.215	-0.400	-0.186
30	0.454	0.080	0.212	0.126	0.148	0.104	0.068	0.018	0.029	-0.092	0.065	-0.173	0.179	-0.189	0.344
31	0.377	-0.206	0.052	-0.142	0.131	-0.043	0.127	0.024	0.041	0.010	-0.086	-0.096	-0.197	-0.271	-0.234
32	0.463	0.024	0.215	0.093	0.194	0.119	0.126	0.081	0.060	-0.008	0.041	-0.107	0.093	-0.175	0.212
33	0.297	-0.217	0.011	-0.180	0.111	-0.086	0.146	0.007	0.094	0.039	-0.021	-0.020	-0.150	-0.161	-0.233
34	0.454	-0.028	0.201	0.048	0.223	0.112	0.179	0.122	0.105	0.065	0.046	-0.032	0.041	-0.130	0.109
35	0.225	-0.204	-0.028	-0.199	0.074	-0.127	0.137	-0.031	0.122	0.031	0.037	0.018	-0.086	-0.077	-0.193
36	0.435	-0.068	0.176	0.004	0.234	0.090	0.220	0.139	0.151	0.119	0.070	0.037	0.021	-0.072	0.040
37	0.161	-0.172	-0.058	-0.197	0.029	-0.159	0.104	-0.078	0.124	-0.004	0.078	0.021	-0.019	-0.024	-0.128
38	0.410	-0.092	0.145	-0.035	0.228	0.059	0.244	0.136	0.191	0.149	0.104	0.092	0.028	-0.012	0.006
39	0.109	-0.127	-0.075	-0.177	-0.017	-0.176	0.057	-0.124	0.104	-0.052	0.100	-0.002	0.040	-0.001	-0.054
40	0.383	-0.099	0.113	-0.063	0.209	0.025	0.249	0.115	0.219	0.156	0.141	0.128	0.053	0.042	0.001
41	0.069	-0.080	-0.079	-0.144	-0.055	-0.178	0.007	-0.161	0.071	-0.104	0.103	-0.040	0.084	-0.004	0.016

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	1.000														
17	0.004	1.000													
18	0.937	0.306	1.000												
19	-0.277	0.944	0.025	1.000											
20	0.774	0.544	0.944	0.309	1.000										
21	-0.502	0.794	-0.250	0.947	0.034	1.000									
22	0.563	0.690	0.803	0.532	0.952	0.297	1.000								
23	-0.644	0.578	-0.479	0.799	-0.240	0.947	0.023	1.000							
24	0.346	0.748	0.615	0.677	0.828	0.510	0.957	0.272	1.000						

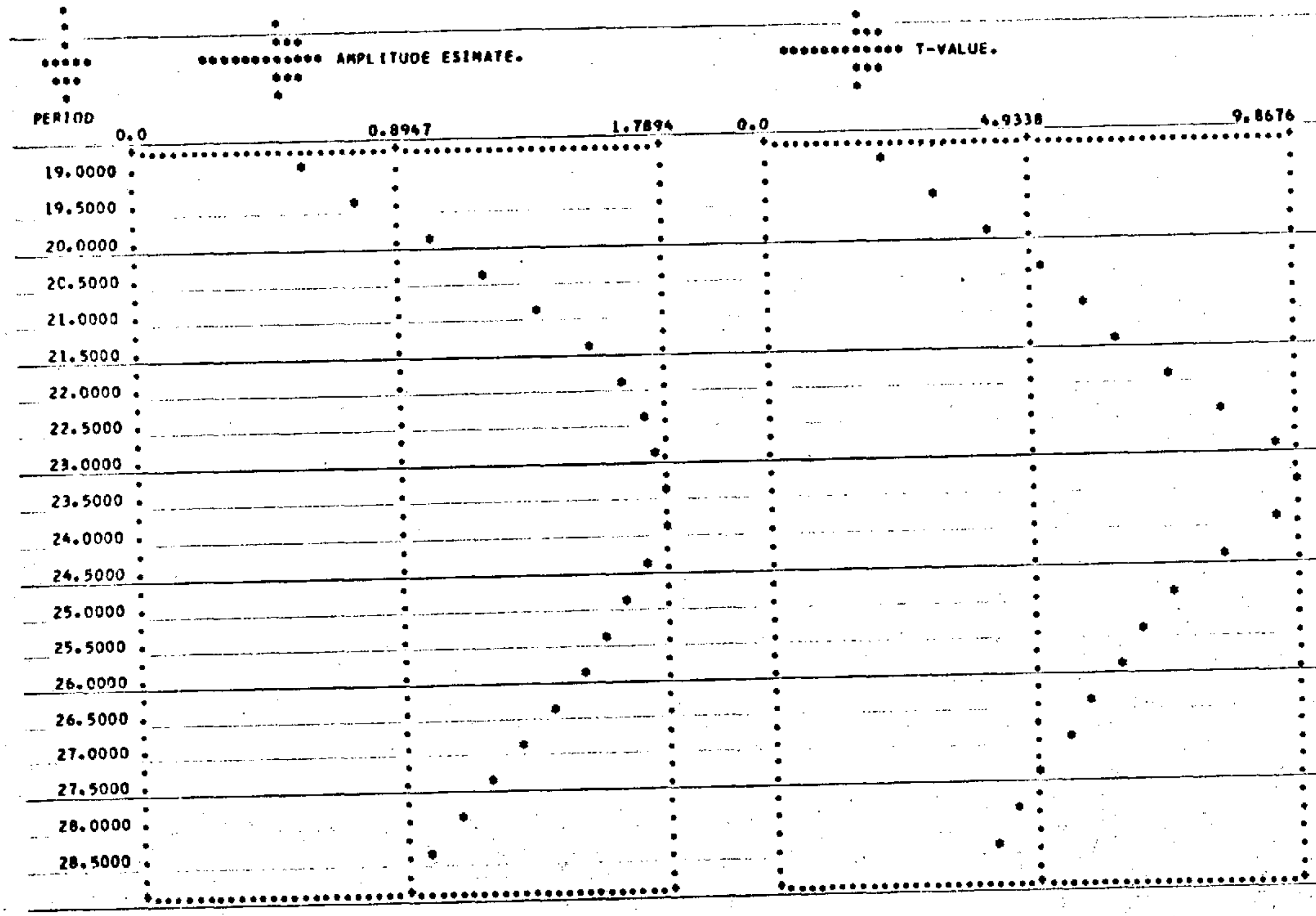
C-2

25	-0.694	0.337	-0.631	0.587	-0.469	0.804	-0.245	0.950	0.005	1.000					
26	0.149	0.726	0.407	0.741	0.650	0.657	0.840	0.484	0.959	0.251	1.000				
27	-0.662	0.116	-0.697	0.358	-0.623	0.607	-0.463	0.820	-0.246	0.956	0.000	1.000			
28	-0.011	0.641	0.205	0.727	0.443	0.729	0.664	0.638	0.842	0.465	0.959	0.246	1.000		
29	-0.578	-0.056	-0.689	0.150	-0.700	0.399	-0.614	0.646	-0.451	0.844	-0.233	0.963	0.013	1.000	
30	-0.121	0.512	0.031	0.649	0.235	0.726	0.458	0.719	0.670	0.624	0.845	0.459	0.961	0.254	1.000
31	-0.468	-0.171	-0.679	-0.017	-0.709	0.205	-0.696	0.457	-0.597	0.688	-0.428	0.863	-0.207	0.966	0.034
32	-0.178	0.370	-0.098	0.531	0.054	0.663	0.254	0.731	0.473	0.714	0.684	0.616	0.856	0.457	0.965
33	-0.349	-0.230	-0.533	-0.134	-0.663	0.042	-0.713	0.271	-0.683	0.510	-0.574	0.718	-0.399	0.873	-0.182
34	-0.190	0.238	-0.177	0.402	-0.083	0.566	0.077	0.690	0.201	0.742	0.503	0.711	0.711	0.608	0.873
35	-0.236	-0.238	-0.417	-0.201	-0.573	-0.083	-0.674	0.103	-0.706	0.324	-0.665	0.542	-0.550	0.730	-0.377
36	-0.168	0.133	-0.210	0.281	-0.173	0.455	-0.059	0.614	0.115	0.719	0.328	0.749	0.549	0.704	0.745
37	-0.138	-0.205	-0.295	-0.221	-0.456	-0.164	-0.588	-0.035	-0.673	0.148	-0.696	0.353	-0.648	0.554	-0.532
38	-0.126	0.059	-0.206	0.180	-0.217	0.346	-0.152	0.519	-0.018	0.660	0.170	0.738	0.385	0.747	0.596
39	-0.064	-0.145	-0.182	-0.201	-0.328	-0.201	-0.474	-0.133	-0.596	-0.002	-0.674	0.173	-0.690	0.367	-0.637
40	-0.073	0.017	-0.174	0.104	-0.223	0.247	-0.204	0.417	-0.114	0.574	0.037	0.688	0.230	0.744	0.438
41	-0.018	-0.074	-0.090	-0.156	-0.209	-0.202	-0.350	-0.191	-0.492	-0.114	-0.611	0.019	-0.682	0.191	-0.689
	31	32	33	34	35	36	37	38	39	40	41				

31	1.000										
32	0.261	1.000									
33	0.968	0.045	1.000								
34	0.451	0.970	0.256	1.000							
35	0.875	-0.171	0.968	0.040	1.000						
36	0.595	0.889	0.435	0.973	0.238	1.000					
37	0.733	-0.366	0.876	-0.174	0.968	0.024	1.000				
38	0.691	0.773	0.576	0.900	0.412	0.975	0.214	1.000			
39	0.561	-0.523	0.738	-0.366	0.880	-0.185	0.970	0.006	1.000		
40	0.739	0.630	0.674	0.789	0.553	0.905	0.387	0.976	0.195	1.000	
41	0.383	-0.630	0.577	-0.517	0.753	-0.366	0.890	-0.190	0.974	-0.002	1.000

SINGLE BAND SPECTRUM

PERIOD	AMPLITUDE	T-VALUE	PHASE
19.000	0.573	2.294	1.363
19.500	0.776	3.185	1.514
20.000	0.996	4.220	-1.429
20.500	1.202	5.191	-1.216
21.000	1.374	5.906	-0.987
21.500	1.527	6.603	-0.758
22.000	1.648	7.517	-0.547
22.500	1.720	8.547	-0.346
23.000	1.762	9.454	-0.144
23.500	1.789	9.858	0.051
24.000	1.784	9.467	0.230
24.500	1.735	8.497	0.403
25.000	1.662	7.549	0.575
25.500	1.583	6.907	0.736
26.000	1.495	6.461	0.877
26.500	1.394	6.026	1.000
27.000	1.284	5.543	1.112
27.500	1.175	5.048	1.216
28.000	1.075	4.583	1.311
28.500	0.985	4.157	1.391



AMPLITUDE ESIMATE.
T-VALUE.
PERIOD
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9.8676
19.0000
19.5000
20.0000
20.5000
21.0000
21.5000
22.0000
22.5000
23.0000
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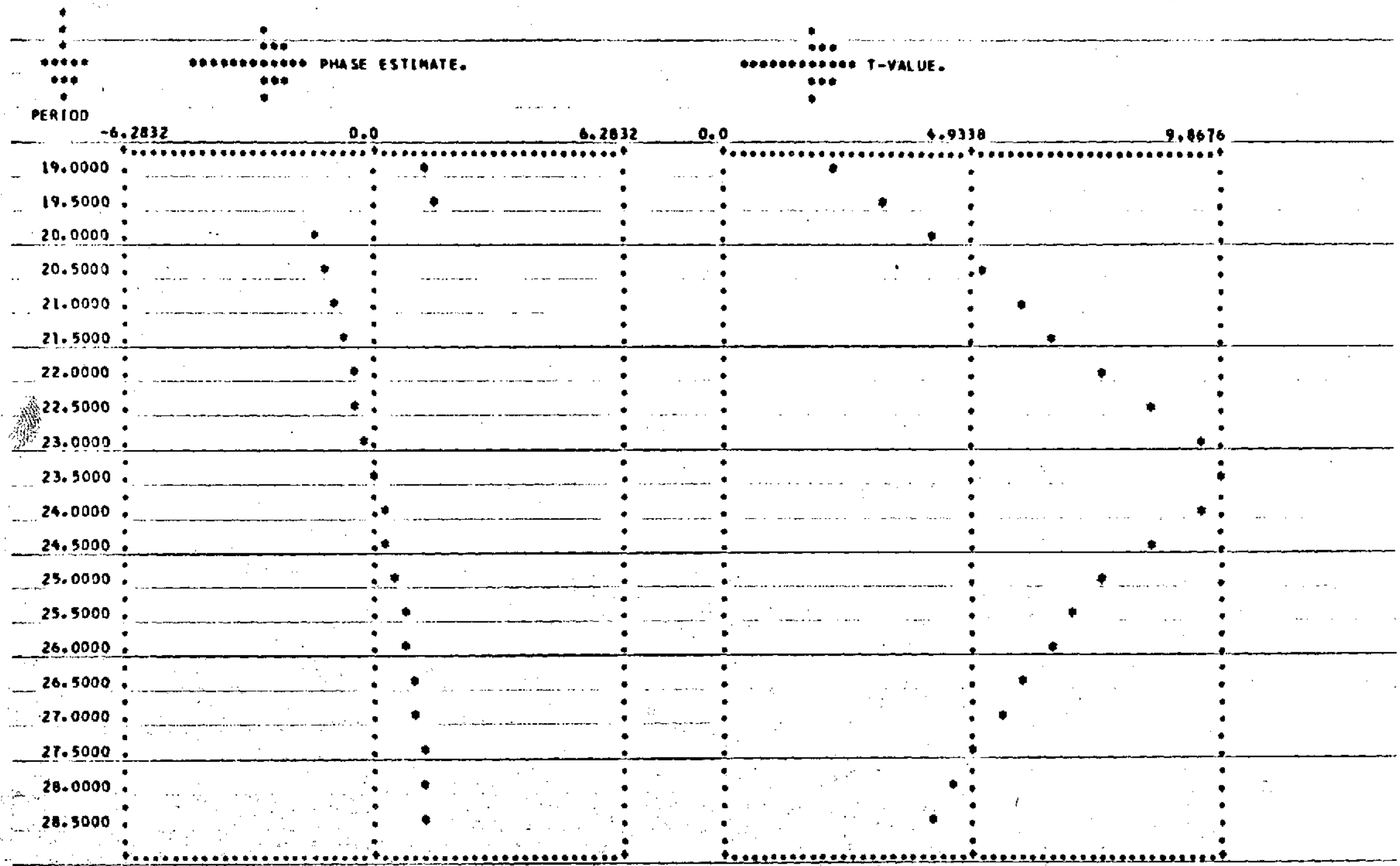
28.0000
28.5000

vi



DETERMINANT = 0.998839259147644E 00

MULTIPLE SQUARED CORRELATION= 0.4982

PERIOD/FREQ.	AMPLITUDE	T-VALUE
23.5000	1.7894	9.8676

DETERMINANT = 0.999392986297607E 00

MULTIPLE SQUARED CORRELATION= 0.4878

PERIOD/FREQ.	AMPLITUDE	T-VALUE
23.0000	1.7620	9.4542

DETERMINANT = 0.999486804008484E 00

MULTIPLE SQUARED CORRELATION= 0.4915

PERIOD/FREQ.	AMPLITUDE	T-VALUE
24.0000	1.7838	9.4675

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL
23.5000

DETERMINANT = 0.104510635137558E-01

MULTIPLE SQUARED CORRELATION= 0.6675

PERIOD/FREQ.	AMPLITUDE	T-VALUE
23.0000	6.3633	10.9500
24.0000	6.6188	12.6390

DETERMINANT = 0.518697053194046E-01

MULTIPLE SQUARED CORRELATION= 0.6676

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	3.1382	13.9762
24.0000	6.6188	12.6390

DETERMINANT = 0.152032911777496E 00

MULTIPLE SQUARED CORRELATION= 0.6648

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.0000	2.0742	9.8360
24.0000	6.6188	12.6390

1x

DETERMINANT = 0.124989524483681E-01

MULTIPLE SQUARED CORRELATION= 0.6654

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	3.1382	13.9762
23.5000	1.7870	22.0729

DETERMINANT = 0.130248904228210E 00

MULTIPLE SQUARED CORRELATION= 0.6680

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	3.1382	13.9762
24.5000	3.3890	13.4829

DETERMINANT = 0.246585547924042E 00

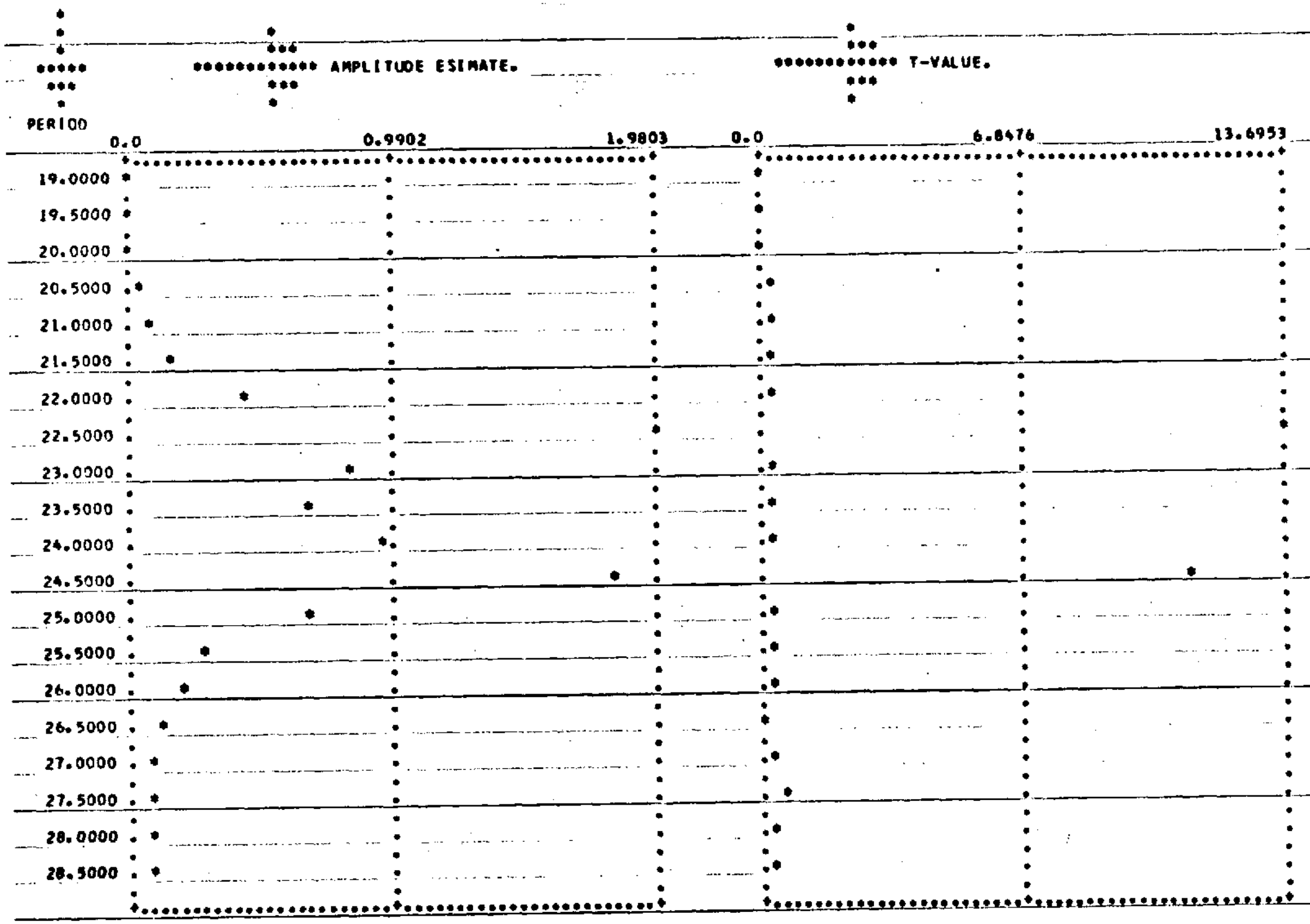
MULTIPLE SQUARED CORRELATION= 0.6666

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	3.1382	13.9762
25.0000	2.3185	12.0589

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL
22.5000
24.5000

MULTIPLE BAND SPECTRUM

PERIOD	AMPLITUDE	T-VALUE	PHASE
19.000	0.017	0.128	1.090
19.500	0.021	0.202	-1.152
20.000	0.032	0.178	-0.436
20.500	0.051	0.299	0.144
21.000	0.086	0.317	0.643
21.500	0.167	0.346	1.093
22.000	0.438	0.418	1.510
22.500	1.980	13.695	0.433
23.000	0.851	0.381	-0.874
23.500	0.681	0.436	-0.512
24.000	0.979	0.414	-0.159
24.500	1.839	11.277	-0.544
25.000	0.691	0.362	0.508
25.500	0.313	0.483	0.836
26.000	0.197	0.402	1.156
26.500	0.144	0.146	1.470
27.000	0.115	0.413	-1.368
27.500	0.098	0.545	-1.076
28.000	0.088	0.536	-0.797
28.500	0.082	0.396	-0.531


AMPLITUDE ESIMATE.
T-VALUE.
PERIOD
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0.0
6.8476
13.6953
19.0000
19.5000
20.0000
20.5000
21.0000
21.5000
22.0000
22.5000
23.0000
23.5000
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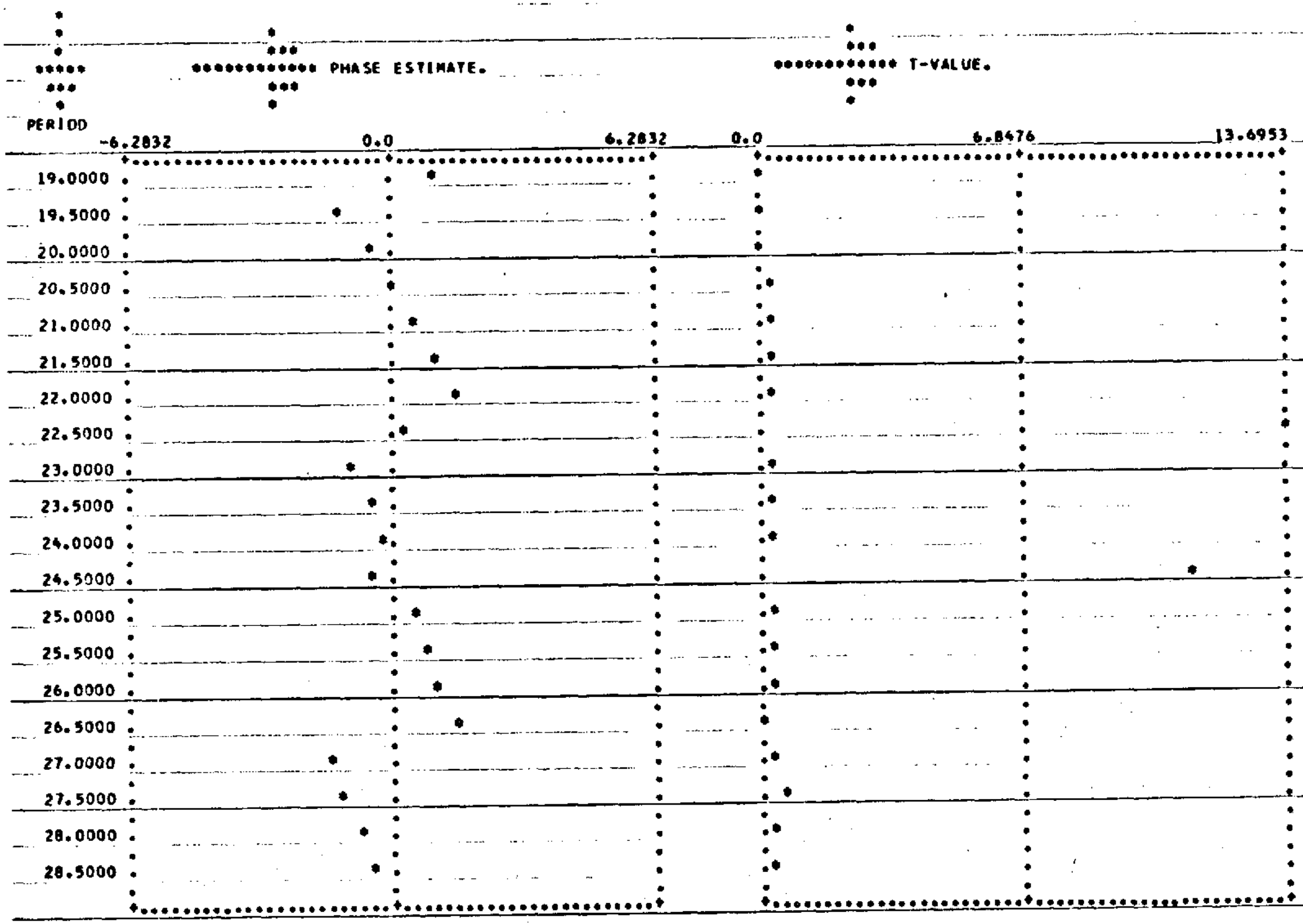
28.5000



MULTIPLE SQUARED CORRELATION= 0.6684

T E S T   2.

THE FOLLOWING IS A LISTING OF THE CONTROL AND DATA CARDS FOR TEST 2.
OUTPUT FOLLOWS.

```
   0     1    20   100     0     1     0     3     2
   20.0       21.0       22.0       22.5       23.0       23.5       24.0       24.5
   25.0       25.5       26.0       26.5       27.0       27.5       28.0       28.5
   29.0       30.0       31.0       32.0
   2
 22.0       1.0
 25.0       1.0
1.0
   1 -3180 -7990-13340 13910  3920  7330  6530  2190 -6810 11290
   2-13770-12570  4950 -1390 -8540  4280-13220 -3150 -7320-13480
   3 23340 -3370-19550 -6360-13180 -4330  5450  4280 -2970  2760
   4-11360  6420 34360-16670  5470-11730 -3550   350  3590  9300
   5  4140  -110  6660-11320 -4100-10770  7340 14840 -3400  7890
   6 -4940  3640-12370  -440 -1110 -2100  9310  6160 -3770 -4330
   7 10480   370  7590  6090-20430 -2900  4040 -5430  4860  8690
   8  3470 28160 -4640 -6320-16140  3720  -740 -9160 13140  -380
   9  6370  5630 -1070  1310-18080-11260  3790  6100 -3640-26260
  10 21760  3930 -9240 19110-10400-11680  4850   760 -7690 16070
```

SIPR

ORIGINAL PAGE IS OF POOR QUALITY

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* * * * * * * PROGRAM PARAMETERS * * * * * * * *
  0   1  20 100   0   1   0   3   2

M O N T E   C A R L O   SIMULATED DATA

BAND  1 - PERIOD=   22.0000, FREQUENCY=    0.0455, AMPLITUDE=    1.0000
BAND  2 - PERIOD=   25.0000, FREQUENCY=    0.0400, AMPLITUDE=    1.0000

RANDOM GAUSSIAN NOISE AMPLITUDE=    1.0000

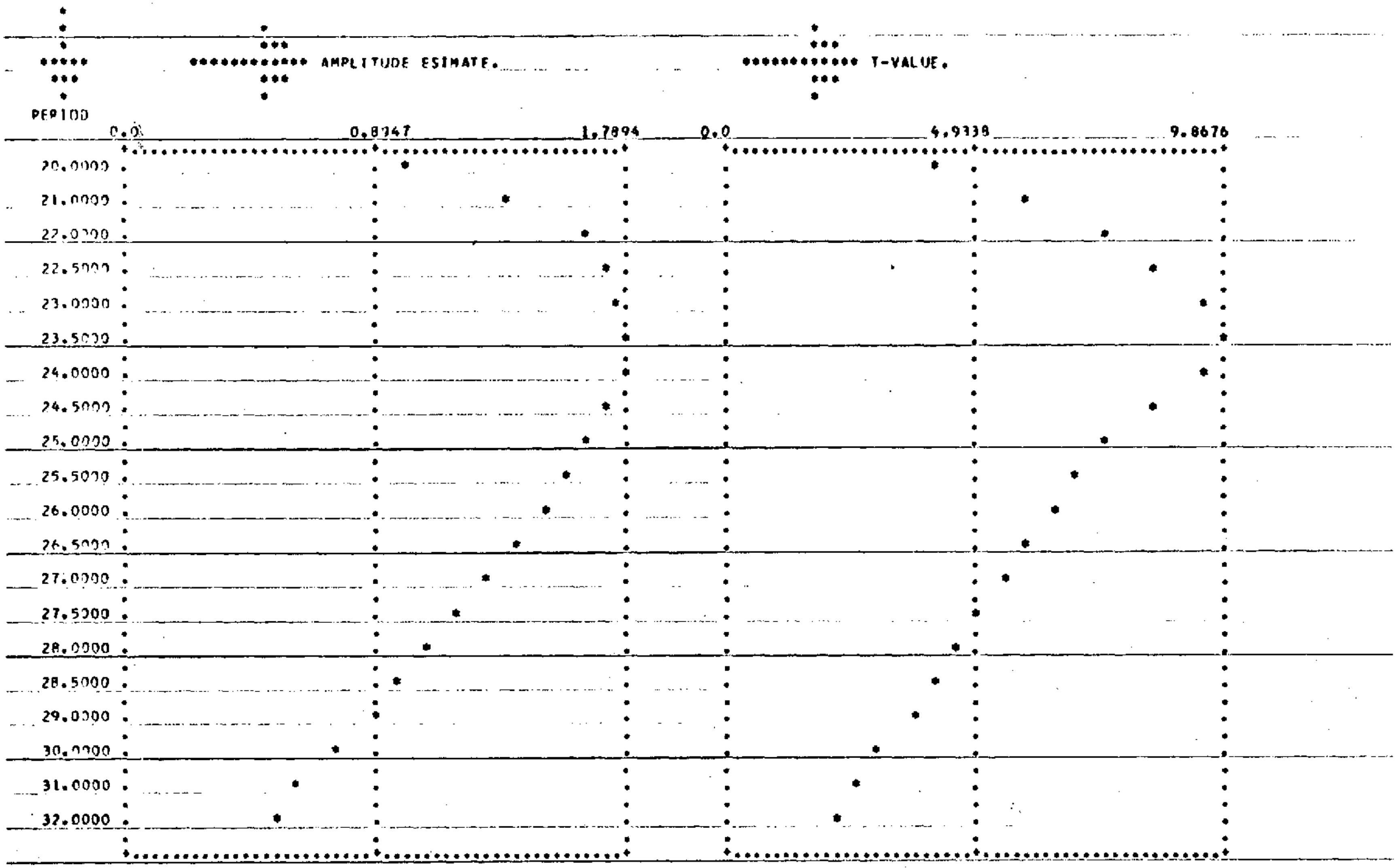
STPR     TIME---1:14.4
```

25	-0.693	0.510	-0.574	0.718	-0.399	0.873	-0.182	0.969	0.045	1.000					
26	0.281	0.762	0.533	0.711	0.711	0.608	0.873	0.451	0.970	0.256	1.000				
27	-0.706	0.324	-0.665	0.542	-0.550	0.730	-0.377	0.875	-0.171	0.969	0.043	1.000			
28	0.115	0.719	0.328	0.749	0.549	0.704	0.745	0.595	0.889	0.435	0.973	0.238	1.000		
29	-0.673	0.168	-0.676	0.353	-0.648	0.554	-0.532	0.733	-0.366	0.876	-0.174	0.968	0.024	1.000	
30	-0.018	0.660	0.170	0.738	0.395	0.747	0.596	0.691	0.773	0.576	0.900	0.412	0.975	0.214	1.000
31	-0.556	-0.002	-0.674	0.173	-0.690	0.367	-0.637	0.561	-0.573	0.739	-0.366	0.880	-0.185	0.970	0.006
32	-0.114	0.574	0.037	0.688	0.230	0.744	0.438	0.739	0.633	0.674	0.789	0.553	0.905	0.387	0.976
33	-0.692	-0.114	-0.611	0.019	-0.682	0.191	-0.699	0.383	-0.630	0.577	-0.517	0.753	-0.366	0.890	-0.190
34	-0.173	0.473	-0.066	0.637	0.092	0.699	0.281	0.740	0.473	0.726	0.648	0.655	0.795	0.531	0.906
35	-0.382	-0.187	-0.525	-0.099	-0.637	0.041	-0.675	0.217	-0.689	0.412	-0.623	0.607	-0.510	0.777	-0.360
36	-0.189	0.261	-0.175	0.394	-0.106	0.521	0.011	0.628	0.162	0.707	0.330	0.731	0.499	0.706	0.660
37	-0.184	-0.230	-0.334	-0.225	-0.486	-0.159	-0.611	-0.040	-0.688	0.122	-0.709	0.312	-0.678	0.506	-0.599
38	-0.118	0.103	-0.172	0.192	-0.188	0.310	-0.154	0.439	-0.072	0.564	0.050	0.666	0.199	0.727	0.365
39	-0.052	-0.175	-0.168	-0.227	-0.309	-0.230	-0.452	-0.180	-0.572	-0.080	-0.656	0.062	-0.697	0.233	-0.695
40	-0.021	0.018	-0.109	0.059	-0.179	0.143	-0.211	0.260	-0.196	0.396	-0.133	0.532	-0.028	0.647	0.110
41	0.003	-0.071	-0.055	-0.146	-0.150	-0.196	-0.269	-0.210	-0.393	-0.181	-0.505	-0.108	-0.597	0.005	-0.659

	31	32	33	34	35	36	37	38	39	40	41
31	1.000										
32	0.155	1.000									
33	0.974	-0.002	1.000								
34	0.369	0.376	0.187	1.000							
35	0.903	-0.185	0.977	0.003	1.000						
36	0.628	0.801	0.508	0.910	0.361	1.000					
37	0.682	-0.478	0.823	-0.324	0.923	0.033	1.000				
38	0.737	0.534	0.697	0.694	0.614	0.926	0.360	1.000			
39	0.411	-0.649	0.579	-0.560	0.724	-0.283	0.928	0.042	1.000		
40	0.723	0.272	0.754	0.442	0.738	0.751	0.594	0.941	0.335	1.000	
41	0.146	-0.687	0.300	-0.675	0.455	-0.529	0.734	-0.272	0.930	0.019	1.000

S I N G L E   B A N D   S P E C T R U M

PERIOD	AMPLITUDE	T-VALUE	PHASE
20.000	0.996	4.220	-1.429
21.000	1.374	5.906	-0.987
22.000	1.643	7.517	-0.547
22.500	1.720	8.547	-0.346
23.000	1.762	9.454	-0.144
23.500	1.789	9.868	0.051
24.000	1.784	9.467	0.230
24.500	1.735	8.497	0.403
25.000	1.662	7.549	0.575
25.500	1.583	6.907	0.736
26.000	1.495	6.461	0.877
26.500	1.394	6.076	1.000
27.000	1.284	5.543	1.112
27.500	1.175	5.048	1.216
28.000	1.075	4.583	1.311
28.500	0.935	4.157	1.391
29.000	0.901	3.764	1.454
30.000	0.750	3.069	1.525
31.000	0.632	2.553	1.538
32.000	0.565	2.247	1.516



AMPLITUDE ESIMATE.
T-VALUE.
PERIOD
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0.0
4.9338
9.8676
20.0000
21.0000
22.0000
22.5000
23.0000
23.5000
24.0000
24.5000
25.0000
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30.0000
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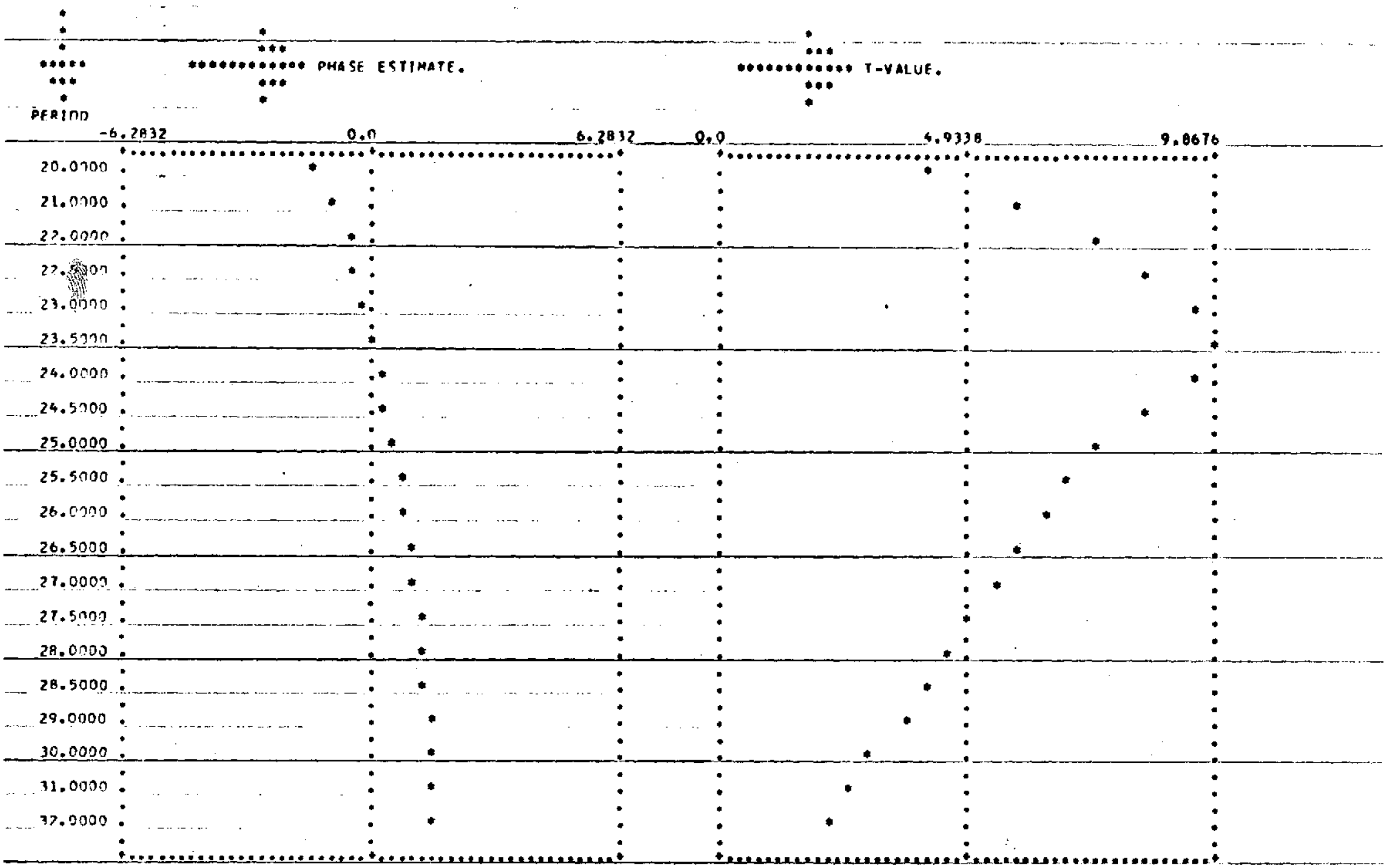
32.0000



DETERMINANT = 0.99883925914764 4E 00

MULTIPLE SQUARED CORRELATION= 0.4982

PERIOD/FREQ.	AMPLITUDE	T-VALUE
23.5000	1.7894	9.8676

DETERMINANT = 0.99939298629760 7F 00

```
MULTIPLE SQUARED CORRELATION=  0.4878
PERIOD/FREQ.        AMPLITUDE            T-VALUE
   23.0000        1.7620              9.4542
```

```
 DETERMINANT =          0.9994868040084848E 00

MULTIPLE SQUARED CORRELATION=  0.4915
PERIOD/FREQ.        AMPLITUDE            T-VALUE
   24.0000        1.7838              9.4675
```

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL
23.5000

DETERMINANT = 0.104510635117558E-01

MULTIPLE SQUARED CORRELATION= 0.6675

PERIOD/FREQ.	AMPLITUDE	T-VALUE
23.0000	6.3633	10.9590
24.0000	6.6188	12.6390

DETERMINANT = 0.518697053194046E-01

MULTIPLE SQUARED CORRELATION= 0.6676

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	1.6127	10.3411
24.0000	6.6188	12.6390

DETERMINANT = 0.152032911777496E 00

MULTIPLE SQUARED CORRELATION= 0.6648

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.0000	-0.9963	-7.6555
24.0000	6.6188	12.6390

DETERMINANT = 0.124989524483681E-01

MULTIPLE SQUARED CORRELATION= 0.6654

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	1.5877	8.0414
23.5000	1.7870	22.0729

DETERMINANT = 0.130248904228210E 00

MULTIPLE SQUARED CORRELATION= 0.6680

PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	1.5738	7.7647
24.5000	3.3890	13.4829

DETERMINANT = 0.246585547924042E 00

MULTIPLE SQUARED CORRELATION= 0.6666

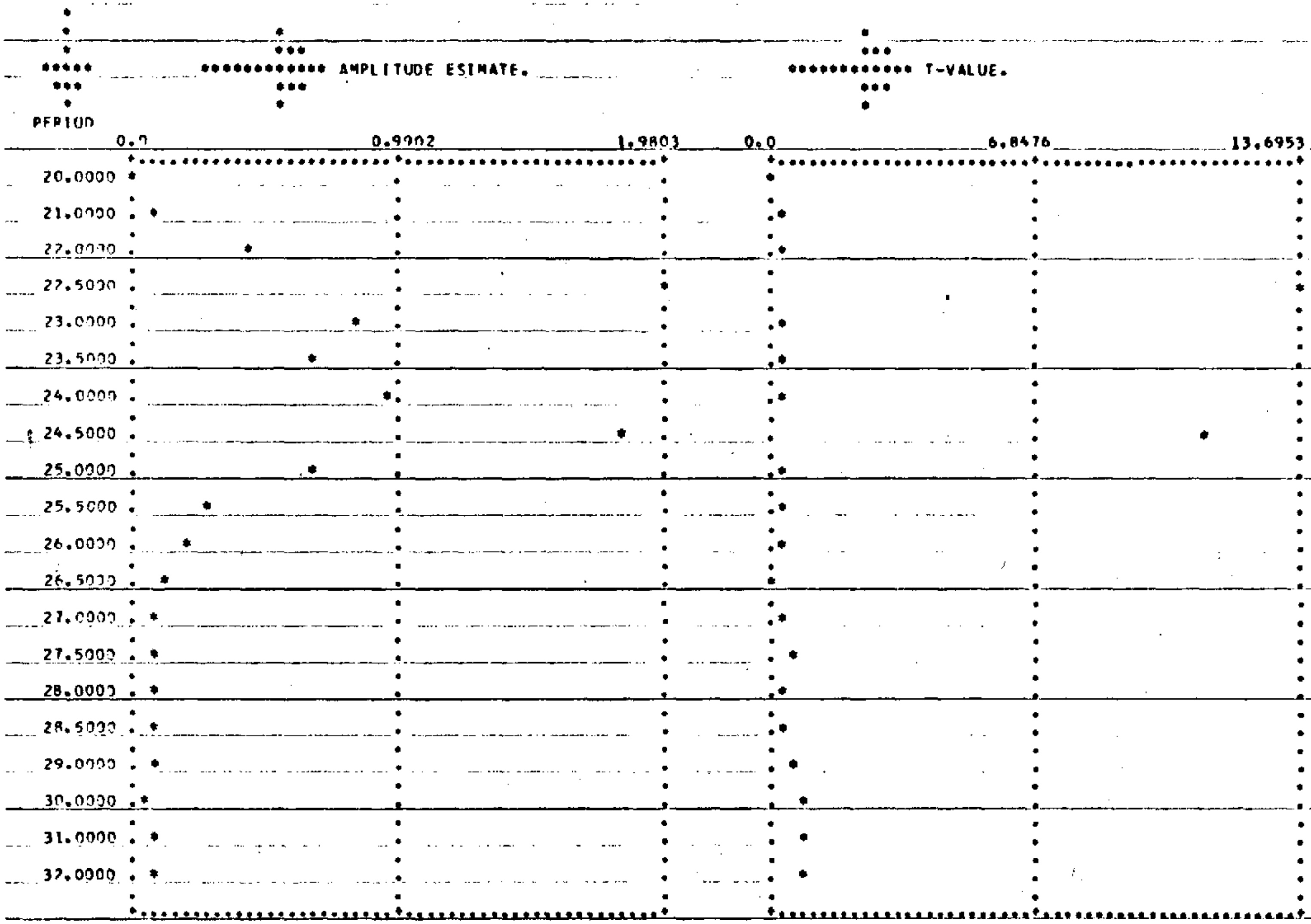
PERIOD/FREQ.	AMPLITUDE	T-VALUE
22.5000	1.4935	8.5366
25.0000	2.3185	12.0589

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL
22.5000
24.5000

M U L T I P L E   B A N D   S P E C T R U M

PERIOD	AMPLITUDE	T-VALUE	PHASE
20.000	0.032	0.178	-0.436
21.000	0.086	0.317	0.643
22.000	0.438	0.413	1.510
22.500	1.980	13.695	0.433
23.000	0.851	0.381	-0.874
23.500	0.681	0.435	-0.512
24.000	0.379	0.414	-0.159
24.500	1.839	11.277	-0.544
25.000	0.691	0.362	0.508
25.500	0.313	0.493	0.836
26.000	0.197	0.402	1.156
26.500	0.144	0.146	1.470
27.000	0.115	0.413	-1.368
27.500	0.098	0.545	-1.076
28.000	0.088	0.536	-0.797
28.500	0.082	0.395	-0.531
29.000	0.079	0.553	-0.279
30.000	0.077	0.854	0.181
31.000	0.080	0.895	0.590
32.000	0.086	1.014	0.954

XX



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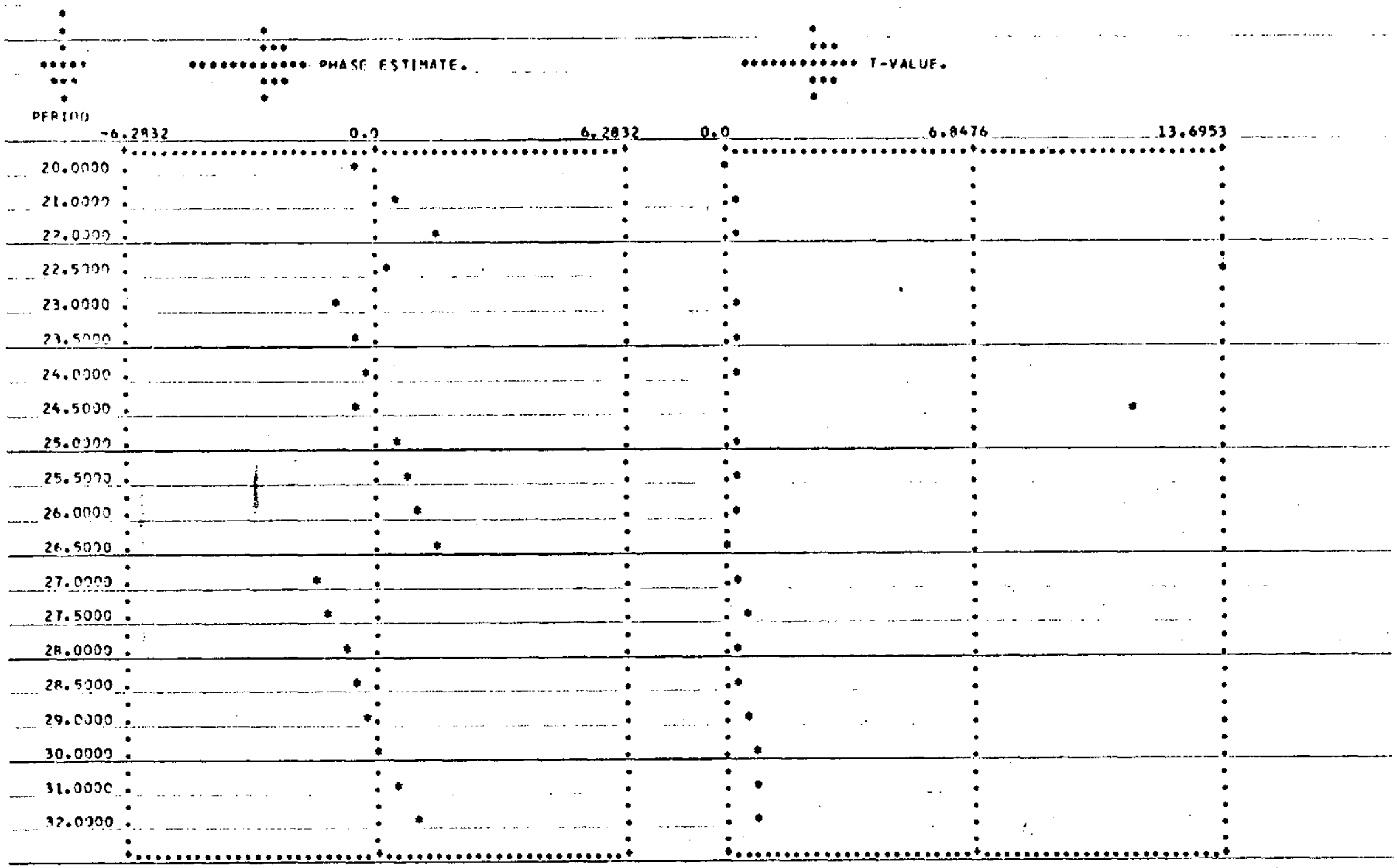
ORIGINAL PAGE IS OF POOR QUALITY



MULTIPLE SQUARED CORRELATION= 0.6590

T E S T   3.

THE FOLLOWING IS A LISTING OF THE CONTROL AND DATA CARDS FOR TEST 3.
OUTPUT FOLLOWS.

```
  1    0   20  100    0    1    0    3    2
  0.035    0.001
  2
 0.045  1.0
 0.040  1.0
0.5
  1 -3180 -7990-13340 13910  3820  7330  6530  2190 -6810 11290
  2-13770-12570  4950 -1390 -8540  4280-13220 -3150 -7120-13480
  3 23340 -3370-19550 -6360-13180 -4330  5450  4280 -2970  2760
  4-11360  6420 30360-16670  5470-11730 -3550   350  3590  9300
  5  4140  -110  6660-11320 -4100-10770  7340 14840 -3400  7890
  6 -4940  3640-12370  -440 -1110 -2100  9310  6160 -3770 -4330
  7 10480   370  7590  6090-20430 -2900  4040 -5430  4860  8690
  8  3470 28160 -4640 -6320-16140  3720  -740 -9160 13140  -380
  9  6370  5630 -1070  1310-18080-11260  3790  6100 -3640-26260
 10 21760  3930 -9240 19110-10400-11680  4850   760 -7690 16070
```

SOPE

******* PROGRAM PARAMETERS ********

1 0 20 100 0 1 0 3 2

MONTE CARLO SIMULATED DATA

BAND 1 - PERIOD= 22.2222, FREQUENCY= 0.0450, AMPLITUDE= 1.0000
BAND 2 - PERIOD= 25.0000, FREQUENCY= 0.0400, AMPLITUDE= 1.000C

RANDOM GAUSSIAN NOISE AMPLITUDE= 0.5000

SDPR TIME---1:12.6

MATRIX OF CORRELATIONS

VARIABLE 1 IS THE DEPENDENT VARIABLE, ALL OTHERS ARE COSINE AND SINE WAVES OF VARIOUS PERIODS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000														
2	-0.142	1.000													
3	-0.022	0.012	1.000												
4	-0.179	0.934	0.320	1.000											
5	-0.046	-0.281	0.939	0.027	1.000										
6	-0.237	0.758	0.565	0.938	0.326	1.000									
7	-0.059	-0.525	0.763	-0.276	0.935	0.023	1.000								
8	-0.314	0.319	0.709	0.771	0.564	0.941	0.315	1.000							
9	-0.047	-0.670	0.504	-0.527	0.750	-0.287	0.932	0.006	1.000						
10	-0.403	0.262	0.739	0.532	0.705	0.772	0.556	0.938	0.304	1.000					
11	-0.091	-0.697	0.225	-0.676	0.491	-0.535	0.749	-0.299	0.935	0.000	1.000				
12	-0.485	0.032	0.655	0.264	0.729	0.521	0.701	0.759	0.554	0.934	0.309	1.000			
13	0.083	-0.622	-0.012	-0.708	0.223	-0.691	0.503	-0.538	0.763	-0.293	0.939	0.016	1.000		
14	-0.536	-0.128	0.491	0.022	0.640	0.243	0.725	0.500	0.703	0.750	0.561	0.934	0.325	1.000	
15	0.207	-0.492	-0.167	-0.639	-0.002	-0.713	0.244	-0.679	0.524	-0.530	0.772	-0.276	0.940	0.034	1.000
16	-0.543	-0.198	0.302	-0.144	0.481	0.003	0.644	0.228	0.733	0.499	0.709	0.757	0.569	0.938	0.332
17	0.362	-0.310	-0.227	-0.492	-0.152	-0.636	0.017	-0.705	0.260	-0.672	0.526	-0.521	0.765	-0.269	0.935
18	-0.501	-0.184	0.142	-0.215	0.306	-0.155	0.499	0.002	0.662	0.240	0.742	0.519	0.712	0.772	0.567
19	0.525	-0.149	-0.194	-0.305	-0.209	-0.474	-0.141	-0.617	0.019	-0.695	0.247	-0.668	0.504	-0.523	0.749
20	-0.408	-0.112	0.042	-0.198	0.157	-0.217	0.331	-0.146	0.519	0.020	0.669	0.264	0.739	0.534	0.707
21	0.670	-0.035	-0.102	-0.132	-0.180	-0.280	-0.206	-0.452	-0.149	-0.607	-0.000	-0.695	0.223	-0.673	0.487
22	-0.262	-0.013	0.013	-0.115	0.061	-0.188	0.176	-0.201	0.340	-0.129	0.514	0.034	0.654	0.266	0.728
23	0.778	0.012	0.005	-0.015	-0.099	-0.113	-0.189	-0.269	-0.221	-0.455	-0.165	-0.620	-0.013	-0.705	0.220
24	-0.078	0.076	0.046	-0.093	0.029	-0.095	0.069	-0.168	0.171	-0.188	0.320	-0.127	0.487	0.023	0.637
25	0.843	-0.001	0.030	0.029	-0.003	-0.007	-0.116	-0.116	-0.207	-0.286	-0.232	-0.478	-0.166	-0.615	-0.003
26	0.115	0.127	0.114	0.093	0.054	0.016	0.026	-0.081	0.054	-0.165	0.148	-0.197	0.298	-0.144	0.477
27	0.850	-0.057	0.129	0.006	0.075	0.025	-0.020	-0.021	-0.128	-0.137	-0.207	-0.306	-0.222	-0.487	-0.150
28	0.234	0.131	0.183	0.145	0.111	0.105	0.041	0.018	0.037	-0.091	0.037	-0.184	0.140	-0.216	0.304
29	0.787	-0.125	0.113	-0.061	0.112	-0.078	0.065	0.007	-0.020	-0.037	-0.115	-0.145	-0.187	-0.299	-0.203
30	0.442	0.095	0.229	0.145	0.173	0.148	0.095	0.096	0.025	-0.000	0.000	-0.113	0.043	-0.199	0.159
31	0.654	-0.177	0.057	-0.139	0.101	-0.079	0.111	-0.024	0.076	-0.000	-0.000	-0.031	-0.093	-0.125	-0.172
32	0.542	0.034	0.233	0.098	0.213	0.135	0.159	0.130	0.038	0.077	0.031	-0.014	0.017	-0.116	0.067
33	0.513	-0.195	-0.013	-0.195	0.055	-0.153	0.112	-0.096	0.130	-0.019	0.094	0.017	0.013	-0.008	-0.092
34	0.577	-0.028	0.193	0.024	0.216	0.078	0.206	0.114	0.164	0.117	0.104	0.075	0.053	-0.004	0.038
35	0.360	-0.179	-0.072	-0.214	-0.003	-0.203	0.075	-0.149	0.133	-0.070	0.143	0.005	0.095	0.037	-0.000
36	0.557	-0.069	0.129	-0.047	0.184	0.003	0.219	0.063	0.220	0.111	0.182	0.126	0.121	0.093	0.063
37	0.218	-0.133	-0.101	-0.190	-0.054	-0.211	0.018	-0.189	0.091	-0.129	0.135	-0.050	0.131	0.015	0.074
38	0.503	-0.079	0.067	-0.090	0.133	-0.060	0.200	0.000	0.240	0.073	0.235	0.132	0.189	0.147	0.117
39	0.100	-0.072	-0.090	-0.129	-0.080	-0.173	-0.040	-0.189	0.021	-0.170	0.079	-0.119	0.113	-0.053	0.107
40	0.434	-0.058	0.024	-0.095	0.082	-0.093	0.156	-0.051	0.220	0.020	0.249	0.097	0.232	0.148	0.175
41	0.021	-0.018	-0.048	-0.056	-0.074	-0.105	-0.076	-0.151	-0.049	-0.177	0.000	-0.171	0.054	-0.132	0.094

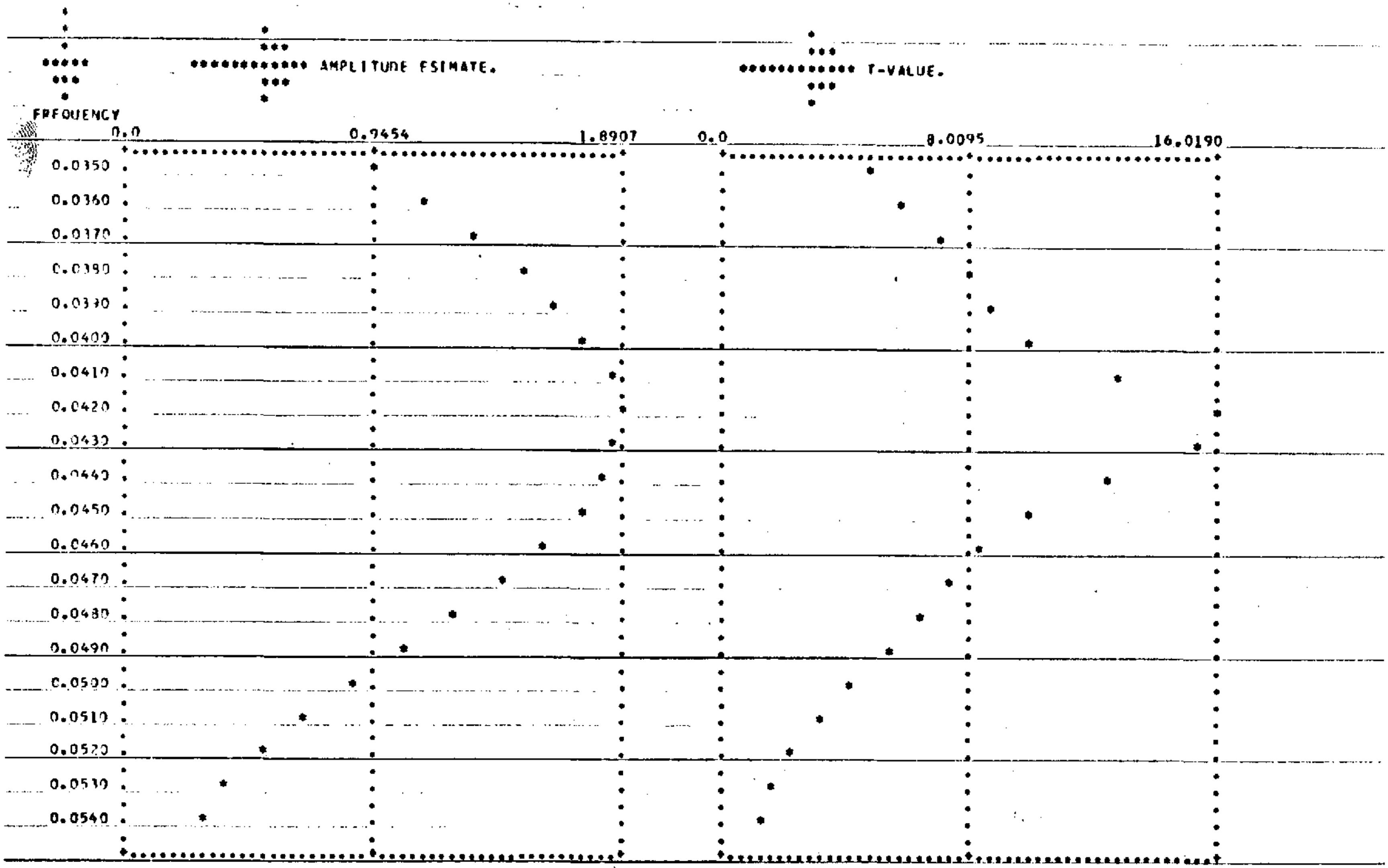
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	1.000														
17	0.029	1.000													
18	0.941	0.320	1.000												
19	-0.282	0.912	0.008	1.000											
20	0.774	0.558	0.939	0.304	1.000										
21	-0.533	0.746	-0.298	0.934	-0.001	1.000									
22	0.523	0.701	0.760	0.553	0.934	0.307	1.000								
23	-0.678	0.499	-0.537	0.761	-0.295	0.939	0.013	1.000							
24	0.244	0.723	0.499	0.702	0.748	0.560	0.933	0.324	1.000						

25	-0.709	0.242	-0.677	0.523	-0.530	0.772	-0.278	0.941	0.932	1.000					
26	0.003	0.641	0.226	0.733	0.496	0.719	0.756	0.569	0.933	0.332	1.000				
27	-0.610	0.013	-0.709	0.263	-0.669	0.527	-0.520	0.765	-0.270	0.935	0.029	1.000			
28	-0.156	0.498	0.000	0.664	0.239	0.745	0.518	0.714	0.772	0.569	0.941	0.329	1.000		
29	-0.467	-0.137	-0.609	0.020	-0.689	0.748	-0.666	0.505	-0.522	0.749	-0.282	0.932	0.008	1.000	
30	-0.218	0.334	-0.147	0.526	0.020	0.676	0.265	0.745	0.537	0.710	0.775	0.559	0.939	0.305	1.000
31	-0.272	-0.202	-0.443	-0.147	-0.600	-0.000	-0.691	0.222	-0.672	0.487	-0.532	0.747	-0.297	0.934	0.000
32	-0.188	0.184	-0.200	0.350	-0.128	0.524	0.936	0.663	0.269	0.734	0.525	0.705	0.760	0.556	0.934
33	-0.104	-0.136	-0.251	-0.723	-0.449	-0.168	-0.617	-0.016	-0.706	0.219	-0.679	0.500	-0.536	0.763	-0.292
34	-0.394	0.078	-0.166	0.180	-0.185	0.330	-0.174	0.496	0.025	0.643	0.244	0.728	0.499	0.706	0.747
35	0.002	-0.118	-0.110	-0.213	-0.283	-0.240	-0.480	-0.172	-0.640	-0.005	-0.713	0.244	-0.677	0.527	-0.526
36	0.018	0.034	-0.078	0.061	-0.162	0.155	-0.195	0.304	-0.143	0.482	0.002	0.645	0.225	0.737	0.494
37	0.034	-0.027	-0.016	-0.139	-0.137	-0.220	-0.312	-0.232	-0.496	-0.155	-0.639	0.019	-0.704	0.265	-0.668
38	0.107	0.046	0.021	0.011	-0.089	0.040	-0.184	0.142	-0.217	0.307	-0.158	0.501	-0.002	0.668	0.237
39	-0.001	0.055	0.019	-0.033	-0.038	-0.130	-0.151	-0.199	-0.309	-0.210	-0.476	-0.139	-0.615	0.023	-0.690
40	0.150	0.095	0.097	0.024	-0.000	-0.001	-0.115	0.042	-0.203	0.169	-0.221	0.337	-0.149	0.529	0.020
41	-0.074	0.101	-0.022	0.063	-0.002	-0.013	-0.036	-0.104	-0.133	-0.180	-0.278	-0.205	-0.446	-0.147	-0.600

	31	32	33	34	35	36	37	38	39	40	41
31	1.000										
32	0.310	1.000									
33	0.940	0.019	1.000								
34	0.565	0.932	0.332	1.000							
35	0.776	-0.270	0.941	0.043	1.000						
36	0.714	0.755	0.576	0.938	0.342	1.000					
37	0.532	-0.514	0.767	-0.259	0.936	0.040	1.000				
38	0.748	0.519	0.718	0.774	0.575	0.942	0.327	1.000			
39	0.251	-0.662	0.505	-0.515	0.747	-0.275	0.930	0.013	1.000		
40	0.678	0.267	0.746	0.540	0.712	0.778	0.562	0.940	0.306	1.000	
41	0.000	-0.689	0.220	-0.667	0.482	-0.528	0.742	-0.296	0.933	-0.002	1.000

S I N G L E   B A N D   S P E C T R U M

FREQUENCY	AMPLITUDE	T-VALUE	PHASE
0.035	0.958	4.778	1.523
0.036	1.131	5.852	1.374
0.037	1.318	6.995	1.198
0.038	1.499	7.972	1.014
0.039	1.644	8.699	0.813
0.040	1.758	10.351	0.588
0.041	1.851	12.978	0.357
0.042	1.891	16.019	0.135
0.043	1.866	15.533	-0.092
0.044	1.810	12.562	-0.325
0.045	1.729	9.966	-0.547
0.046	1.601	8.333	-0.762
0.047	1.438	7.465	-0.983
0.048	1.267	6.630	-1.202
0.049	1.085	5.552	-1.401
0.050	0.898	4.360	1.567
0.051	0.700	3.310	1.421
0.052	0.518	2.483	1.328
0.053	0.407	1.859	1.321
0.054	0.317	1.438	1.419


AMPLITUDE ESIMATE.
T-VALUE.
FREQUENCY
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0.0
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16.0190
0.0350
0.0360
0.0370
0.0380
0.0390
0.0400
0.0410
0.0420
0.0430
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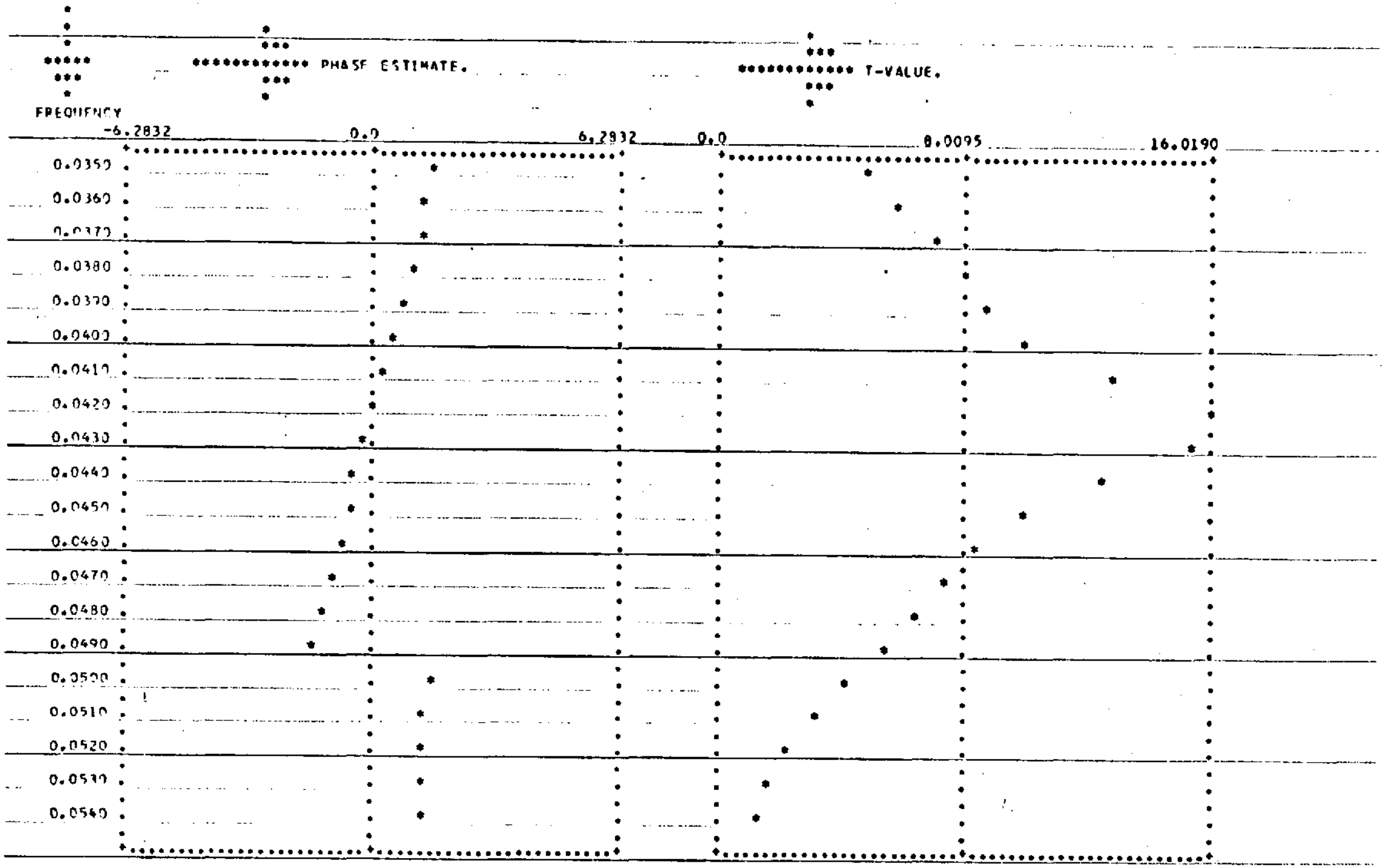

DETERMINANT = 0.999163687229157E 00

MULTIPLE SQUAREC CORRELATION= 0.7308

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0470	1.8907	16.0190

DETERMINANT = 0.998968720436096E 00

MULTIPLE SQUARED CORRELATION= 0.7217

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0460	1.8660	15.5327

DETERMINANT = 0.999933779239655E 00

MULTIPLE SQUARED CORRELATION= 0.7015

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0480	1.8510	12.9776

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL
0.0470

DETERMINANT = 0.151127241551876E-01

MULTIPLE SQUARED CORRELATION= 0.8873

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0460	5.0615	13.9587
0.0480	4.9467	25.1598

DETERMINANT = 0.677171349525452E-01

MULTIPLE SQUARED CORRELATION= 0.8900

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0450	2.5702	24.9926
0.0480	4.9467	25.1598

DETERMINANT = 0.179735481739044E 00

MULTIPLE SQUARED CORRELATION= 0.8893

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0440	1.7457	19.2663
0.0480	4.9467	25.1598

DETERMINANT = 0.153529718518257E-01

MULTIPLE SQUARED CORRELATION= 0.8882

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0450	2.5702	24.9926
0.0470	1.8832	36.9735

DETERMINANT = 0.177635967731476E 00

MULTIPLE SQUARED CORRELATION= 0.8893

PERIOD/FREQ.	AMPLITUDE	T-VALUE
0.0450	2.5702	24.9926
0.0490	2.4549	22.6255

COMPUTING SPECTRUM USING THE FOLLOWING BANDS IN MODEL

0.0450
0.0480

MULTIPLE BAND SPECTRUM

FREQUENCY	AMPLITUDE	T-VALUE	PHASE
0.035	0.062	1.095	-1.280
0.036	0.032	1.125	-1.591
0.037	0.115	0.899	1.400
0.038	0.176	0.710	1.148
0.039	0.312	1.214	0.897
0.040	0.773	1.063	0.619
0.041	1.931	23.878	-0.612
0.042	1.552	1.316	0.072
0.043	1.573	1.477	-0.199
0.044	1.976	27.862	0.535
0.045	0.932	1.149	-0.763
0.046	0.343	1.359	-1.047
0.047	0.204	1.175	-1.335
0.048	0.140	0.339	1.515
0.049	0.106	1.330	1.218
0.050	0.095	1.412	0.916
0.051	0.072	1.183	0.608
0.052	0.064	1.473	0.293
0.053	0.058	1.628	-0.030
0.054	0.054	1.402	-0.360

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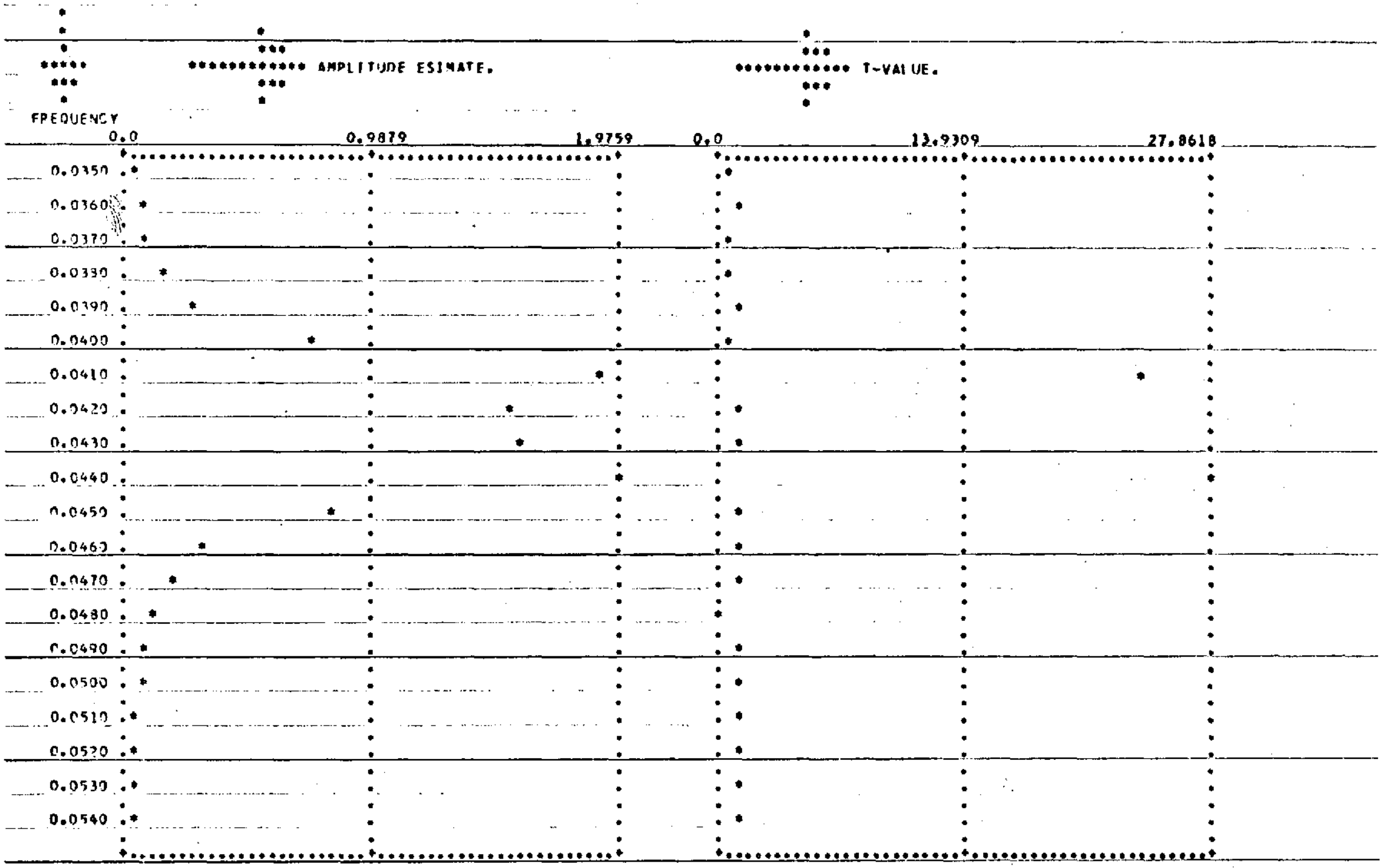

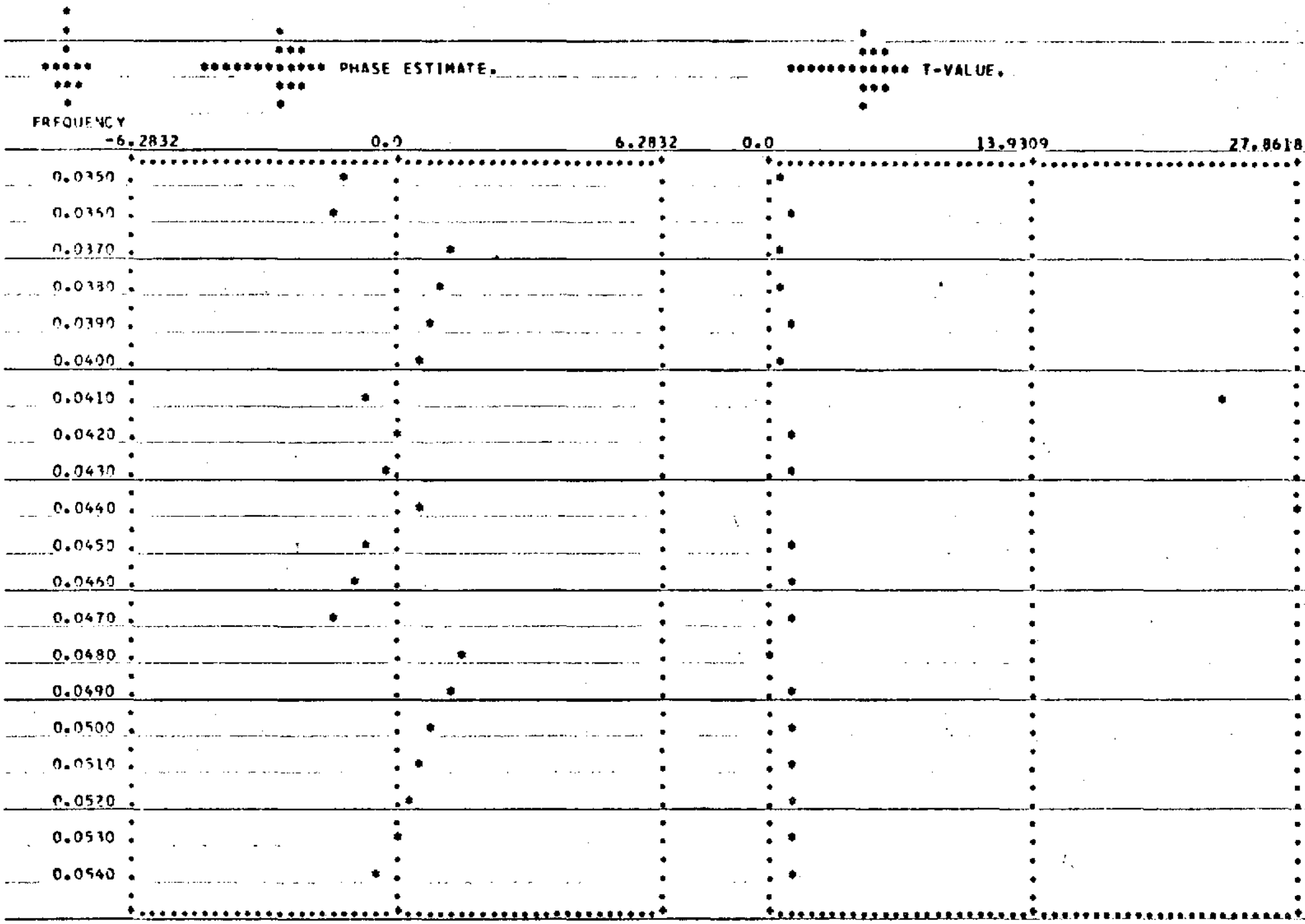

MULTIPLE SQUARED CORRELATION= 0.8903